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REVISION OF THE CHELONUS SPECIES DESCRIBED BY A. G. DAHLBOM (HYMENOPTERA, BRACONIDAE: CHELONINAE)

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In 1833 A. G. DAHLBOM reported eight *Chelonus* JURINE species from Sweden of which six were described as new to science. Redescriptions and taxonomic status of the four species are presented, the further four species are referred to. New synonyms are: *Microchelonus gravenhorstii* (NEES, 1816) sen. syn. = *Chelonus maculator* DAHLBOM, 1833, jun. syn.; *Schizoprymnus pullatus* (DAHLBOM, 1833) sen. syn.: = *Sigalphus rufipes* HERRICH-SCHÄFFER, 1838, = *Sigalphus globosus* SZÉPLIGETI, 1898, jun. syns. Designation of the neotype for the species *Sigalphus* (→ *Microchelonus*) *fenestratus* NEES. With 60 original figures.

Key words: *Chelonus*, redescriptions, synonymies, taxonomic remarks

INTRODUCTION

In the year of 1833 A. G. DAHLBOM (1806–1859) published a paper with a report of eight *Chelonus* JURINE species from Sweden. From among the eight species six had been described as new species to science. In the subsequent checklist of the eight species the first names are the original species names given by DAHLBOM, the second names (in italics) indicate the present, valid specific names except one species (*Ch. oculator*) where the first name remained valid:

Chelonus abdominator DAHLBOM, 1833 = *Ascogaster abdominator* (DAHLBOM)
Chelonus fasciatus DAHLBOM, 1833, **jun. syn.** = *Ascogaster rufipes* (LATREILLE, 1809), *sen. syn.*
Chelonus maculator DAHLBOM, 1833, *jun. syn.* = *Microchelonus gravenhorstii* (NEES, 1816), *sen. syn.*
Chelonus nigritulus DAHLBOM, 1833 = *Microchelonus nigritulus* (DAHLBOM), **comb. n.**
Chelonus oculator (FABRICIUS, 1775)
Chelonus pedator DAHLBOM, 1833 = *Microchelonus pedator* (DAHLBOM), **comb. n.**
Chelonus pullatus DAHLBOM = *Schizoprymnus pullatus* (DAHLBOM), **comb. n.**
Chelonus scabriculus DAHLBOM, 1833 = *Ascogaster scabricula* (DAHLBOM)

From among the eight species four were re-evaluated by HUDDLESTON (1984: *Ch. abdominator, Ch. fasciatus* and *Ch. scabriculus*) as well as by VAN ACHTERBERG (1982: *Ch. oculator*). The rest of the species (i.e. four spp.) are revised in the present study.

Abbreviations applied in the text: *d1* and *d2*: first and second section of the discoidal vein; *r1*, *r2* and *r3*: first, second and third section of the radial vein; OD: diameter of an ocellus, OOL: shortest distance between hind ocellus and eye, POL: shortest distance between hind pair of ocelli.

SPECIES REVISED BY MODERN AUTHORS

Ascogaster abdominator (DAHLBOM, 1833 (*Chelonus*, p. 155): SHENEFELT 1973: 823 (as synonym of *A. instabilis* WESMAEL, 1835). HUDDLESTON 1984: 349 (in key) and 357 (comb. n., synonyms, taxonomic notes, redescription).

Ascogaster rufipes (LATREILLE, 1809) (=*Chelonus fasciatus* DAHLBOM, 1833, p. 163): Synonymized by THOMSON 1874: 583 (see also SHENEFELT 1973: 833–834). HUDDLESTON 1984: 31 (in key) and 378 (synonyms, taxonomic notes, redescription).

Ascogaster scabricula (DAHLBOM, 1833) (*Chelonus*, p. 166): SHENEFELT 1973: 83 (as synonym of *A. similis* [NEES, 1816]). HUDDLESTON 1984: 351 (in key) and 379 (synonym, taxonomic notes, redescription).

Chelonus oculator (FABRICIUS, 177) (*Ichneumon*, p. 19) (=*Ichneumon* → *Chelonus oculator* PANZER, 1779): VAN ACHTERBERG 1982: 187 (neotype, redescription, taxonomic notes).

TAXONOMIC RESULTS
(Species revised herewith)

Subsequently four species of the genus *Chelonus* JURINE, 1801 created by DAHLBOM are revised and redescribed. The species are compared to the related or to the taxonomically nearest species. Synonyms and necessary taxonomic notes are presented, sixty original figures help the recognition of the species treated here. From among the four chelonine species DAHLBOM the herewith revised three species are assigned to the genus *Microchelonus* SZÉPLIGETI, 1908 (*M. gravenhorstii* NEES = *M. maculator* DAHLBOM jun. syn.; *M. nigritulus* DAHLBOM; *M. pedator* DAHLBOM) and one species to the genus *Schizoprymnus* FÖRSTER, 1862 (*Sch. pullatus* DAHLBOM). For the European species of the two genera *Microchelonus* and *Schizoprymnus* a fairly good identification key of each was constructed by TOBIAS (1986*a*, *Microchelonus*: pp. 317–335, *Schizoprymnus*: pp. 172–180). Since the publication of this book, TOBIAS himself described a series of new *Microchelonus* species (in several papers) from the European part of the former USSR (TOBIAS 1985–1995).

Microchelonus (Parachelonus) gravenhorstii (NEES) (Figs 1–14)

Sigalphus gravenhorstii NEES, 1816: Mag. Ges. Naturf. Fr. Berlin 7 (1813): 272 "♀" (= ♂) "♂" (= ♀) (syntype series: four females), type locality: "Habitat in Germania", lectotype ♀ in Museum für Naturkunde Berlin, lectotype designated by TOBIAS 1995: 40.

Chelonus gravenhorstii (NEES): NEES 1834 Hym. Ichn. aff. Mon. 1: 296 ♂♀ comb. n. SHENEFELT 1973: 852 (literature up to 1958). TOBIAS 1986*a*: 311 (in key, "Chelonus gravenhorsti Wesm.": the author's name WESMAEL is evidently a lapsus).

Microchelonus (Parachelonus) gravenhorstii (NEES): TOBIAS 1995: 40 (comb. n., lectotype and paralectotypes designation, short redescription, taxonomic remarks).

Chelonus adjaricus TOBIAS, 1976: Braconidae of Caucasus, Key to the Fauna of the USSR 110: 26 ♀, type locality: Georgia, Batumi, Botanical Garden, holotype in Zoological Institute, Sankt Petersburg, examined; synonymized by TOBIAS 1986*a*: 315.

Chelonus eurytheca WESMAEL, 1838: Nouv. Mém. Acad. Brux. 11: 158 "♀" = ♂ (syntype series: eight males), type locality: "environs de Bruxelles" (Belgium), lectotype ♂ in Institut Royal des Sciences Naturelle Belgique Bruxelles, examined; synonymized by THOMSON 1874: 573. – SHENEFELT 1973: 894 (as synonym of *Microchelonus parcicornis* HERRICH-SCHÄFFER, 1838 after REINHARD 1867: 359). PAPP 1995: 126 (as synonym of *M. gravenhorstii* NEES and designation of male lectotype).

Chelonus maculator DAHLBOM, 1833: Kön. svenska VetenskAkad. Handl. 53 (1832): 162 "♂" = ♀ (syntype series: one female), type locality: "Skåne... Esperöd..." (Sweden), holotype ♀ in Museum of Zoology Lund (present designation, examined), **syn. n.** – SHENEFELT 1973: 856 (as valid species, literature up to 1934).

Chelonus tricolor TOBIAS, 1976: Braconidae of Caucasus. Key to the Fauna of the USSR 110: 147 (in key) and 236 (description) ♀, type locality: Azerbaijan, Kalaibugurt, holotype ♀ in Zoological Institute, Sankt Petersburg, examined. – TOBIAS 1986*a*: 315 (in key as valid species); 1995: 40 (synonymization).

Taxonomic remarks. – 1. The female lectotype and nine female paralectotypes of *Sigalphus gravenhorstii* NEES had been designated by TOBIAS (1995: 40–42) which type-series is deposited in the Museum für Naturkunde (Zoologisches Museum), Berlin. Out of the ten type specimens I have seen the female lectotype and four female paralectotypes. – In his original description NEES (l. c.) has indicated that "Feminam benevole communicavit Vir amicissimus KLUG" (the female is described by my good friend KLUG's kindness), i.e. NEES received the females from KLUG's Collection which is at the moment (at least partly) in the Berlin Museum (by the way, it is known that J. C. F. KLUG and C. F. NEES ab Esenbeck had a good personal connection). Consequently, I regard the ten female specimens as the syntype series of *Sigalphus gravenhorstii* proper for the designation of the lecto- and paralectotypes which consideration agrees well with that of TOBIAS (l. c.).

2. Designation of the female holotype of *Chelonus maculator* DAHLBOM: "S. maculator. ♂. Zett." (first label with handwriting; the author name "Zett."erstedt is an evident mistake) – "Sweden Skåne Esperöd" (second label, type locality adopted after DAHLBOM, label written and attached by me) – the third label

is my holotype card. – Remark: In the original description it is indicated in Swedish that one single specimen had been found (and served for the description): "är ett exemplar funnet".

3. In my paper on the *Chelonus* species by WESMAEL I misidentified the female of *Microchelonus fenestratus* (NEES) and erroneously assigned it to the species *Microchelonus gravenhorstii* (NEES) (PAPP 1995: 126–127 and Figs 125–126). At this time (i.e. in 1993) I did not know the genuine female form of *M. fenestratus*, since I received the type-series of this species from the Berlin Museum later. Herewith I rectify my identification with the assertion that Figs 125–126 depict the female carapace (Fig. 125) and hind femur (Fig. 126) of *M. fenestratus* (NEES) (and not *M. gravenhorstii* NEES). I feel it reasonable to indicate that the male form of *M. fenestratus* is unknown so far.

Redescription of the female lectotype of *Sigalphus gravenhorstii* NEES. – Body 4 mm long. Head in dorsal view (Fig. 1) transverse, twice as broad as long, eye twice as long as temple, latter receded. Ocelli almost round, OOL : OD : POL as 10 : 4 : 8. Eye in lateral view 2.1 times as high as wide, temple just wider than eye (Fig. 2, see arrows). Malar space one-fifth longer than basal width of mandible. Face 1.7 times as wide as high, inner margin of eyes parallel. Face and cheek with more or less concentric fine and semicircular striation; clypeus finely punctate, interspaces shiny. Head above and temple also with fine striation (Fig. 1). – Antenna as long as body, with 29 antennomeres. First flagellomere 3.3 times as long as broad apically, further flagellomeres gradually shortening and attenuating so that penultimate six flagellomeres (i.e. 23–28) cubic.

Mesosoma in lateral view 1.4 times as long as high. Notaulix indicated by roughened sculpture. Prescutellar furrow with seven crenulae. Pair of latero-median tubercules small. Mesosoma areolate rugose, mesonotum rugulose to confluently punctate, subshiny, before prescutellar furrow and at meeting of notaulices rugose. – Hind femur 3.1 times as long as broad medially. Hind tibia and tarsus equal in length. Hind basitarsus as long as tarsomeres 2–5.

Fore wing somewhat shorter than body. Pterostigma (Fig. 3) 2.3 times as long as wide, issuing radial vein just distally from its middle. Metacarp one-fifth longer than pterostigma, radial cell along metacarp as long as pterostigma. Veins *r1* and *r2* equal in length, *r3* faintly curved, *d2* twice as long as *d1*.

Carapace in dorsal view (Fig. 4) 1.77 times as long as broad somewhat posteriorly from middle; in lateral view 2.8 times as long as high behind and less than twice as high behind as basally (Fig. 5, see vertical four arrows), its hind end less rounded (Fig. 5, see horizontal arrow); in ventral view (Fig. 6) somewhat incurved. Carapace longitudinally striate, interstriations transversely rugose, hind third of carapace rugose to densely rugose. Ovipositor sheath short.

Ground colour of body black, carapace blackish brown and its anterior third straw yellow. Palpi pale yellow. Antenna brownish black. Tegula brownish yellow. Legs yellow, brownish: basal two-thirds of hind coxa, hind femur and tibia apically, tarsi 1–3 except pale yellow base of basitarsi 1–3.

Redescription of the female paralectotypes (3 ♀♀). – Similar to the lectotype. Body 3.7–4 mm long (3.7: 1 ♀, 4: 2 ♀♀). Antenna of every female damaged. Pterostigma 2.3–2.72 times as long as wide (2.3: 2 ♀♀ , 2.72: 1 ♀). Carapace in dorsal view 1.77–1.9 times as long as broad medially (1.77: 1 ♀ , 1.86: 1 ♀ , 1.9: 1 ♀); in lateral view 2.8 times as long as high behind. Ground colour of carapace black (2 ♀♀).

Redescription of the male (3 ♂♂). – In the Hungarian Natural History Museum (Budapest) there are two male specimens which came from the following localities: 1 ♂ (det. M. W. R. de V. Graham 1952): ??Pencenbe (hardly legible locality in ?England); 1 ♂ (det. VAN ACHTERBERG 1992): Nederland, Holland (N. H.), Texel Island, De Koog; the third male examined is housed in

the Berlin Museum and belongs to the REINHARD Collection and taken in an unknown locality in Germany. These three specimens served for the redescription of the male:

Similar to the female. Body 3.9–4 mm long (3.9: 1 ♂, 4: 2 ♂♂). Head in dorsal view (Fig. 8) twice as broad as long, eye twice (2 ♂♂) and 1.4 times (1 ♂) as long as temple, head above with finer striation than that of female. Antenna nearly as long as body and with 29 antennomeres; penultimate flagellomere subcubic, i.e. 1.2 times as long as broad. Pterostigma 2.3–2.9 times as long as wide (2.3: 1 ♂, 2.7: 1 ♂, 2.9: 1 ♂), *r1* somewhat longer than *r2* (1 ♂). Hind femur 2.94 times as long as broad medially (1 ♂). Carapace in dorsal view (Fig. 11) 1.7–1.9 times as long as broad posteriorly from its middle (1.7:1 ♂; 1.9: 2 ♂♂), carapace distinctly broadening posteriorly; in lateral view (Fig. 12) 3–3.3 times as long as high behind (Fig. 12); in ventral view carapace apically incurved (Fig. 13), incurvation as long as hind tarsomeres 2–3 (1 ♂) or 3–4 (2 ♂♂). Apical foramen elliptic and twice as wide as high (Fig. 9). Ground colour of body black, carapace basally not yellow. Dark colour of legs blackish to black and more extended.

In coupling the female and male forms I rely upon GRAHAM's and VAN ACHTERBERG's identification indicated before and which I accept as authentic taxonomic name, on the one hand, as well as upon NEES's original description (l. c.), on the other, albeit he has considered the female and male forms in an opposite sense. The description by NEES corresponds with the authentic specimens at hand in all respects.

Variable features of the female (15 ♀♀). – Body 3.7–4 mm long (3.7: 1 ♀; 3.9: 3 ♀♀, 4 : 11 ♀♀). Temple in dorsal view rather rounded, i.e. less receded (Fig. 7). Antenna with 26–29 antennomeres (26: 1 ♀, 27: 3 ♀♀; 28: 6 ♀♀; 29: 1 ♀; 4 ♀♀ with damaged antenna), penultimate 5–6 flagellomeres subcubic, i.e. just longer than broad (4 ♀♀) to cubic (7 ♀♀). Pterostigma 2.1–2.7 times as long as wide (2.1: 1 ♀, 2.2: 1 ♀, 2.3: 8 ♀♀; 2.46: 1 ♀, 2.5: 3 ♀♀; 2.7: 1 ♀), issuing radial vein either from its middle (2 ♀♀) or more or less distally from its middle (13 ♀♀). Radial cell along metacarp exceptionally somewhat shorter than pterostigma (2 ♀♀, Fig. 14). Carapace in dorsal view 1.66–1.9 times as long as broad (1.66: 1 ♀; 1.7: 2 ♀♀; 1.77: 2 ♀♀; 1.8: 7 ♀♀; 1.86: 2 ♀♀, 1.9: 1 ♀); in lateral view 2.6–3.2 times as long as high behind (2.6: 1 ♀, 2.8: 3 ♀♀; 2.85: 6 ♀♀; 2.9: 2 ♀♀, 3: 1 ♀, 3.2: 2 ♀♀). Carapace basally either fully straw yellow (12 ♀♀) or more or less divided by a blackish to black streak in a pair of spots (3 ♀♀).

Host unknown.

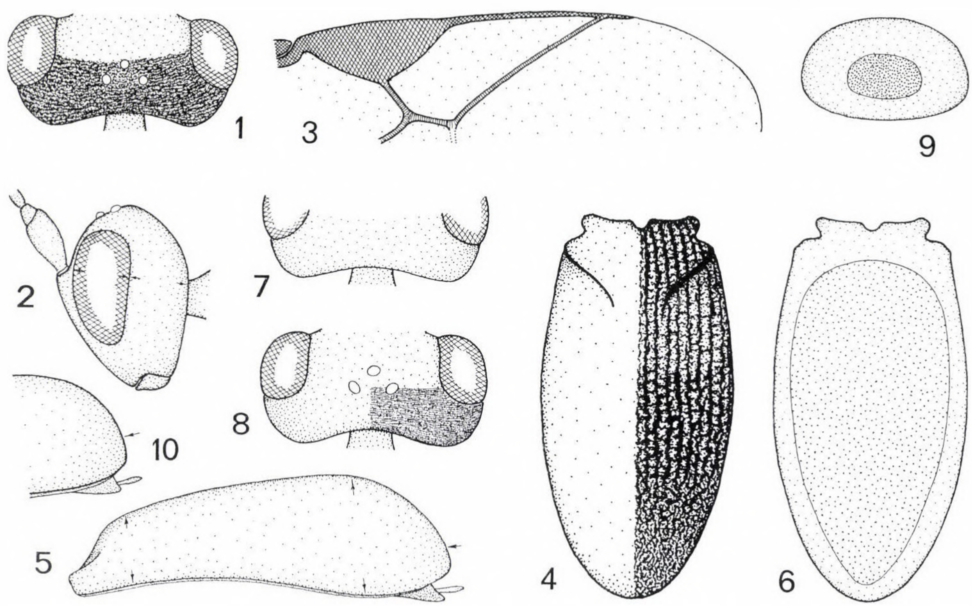
Distribution: Europe, Russia, Mongolia.

Remarks. – 1. The apical foramen of the male carapace, on the one hand, and the female antenna with 26–29 antennomeres, on the other, indicate the transitional taxonomic position of *M. gravenhorstii* between the genera *Microchelonus* and *Chelonus*; antenna of the species belonging to the first genus are with 16 antennomeres. Nevertheless, I relegate the species in question unambiguously to the genus *Microchelonus* considering its following generic features: a) Head above and temple with fine striate sculpture (*Chelonus*: usually strongly and rather roughly strio-rugose), b) Carapace in lateral view 2.6–3.2 times as long as high behind (*Chelonus*: usually 2–2.3 times as long as high), c) Third femur relatively thick, 3.1 times as long as broad (*Chelonus*: usually less thick, 3.2–3.5 times as long as broad) (cf. PAPP 1995: 125–126). – For the transitional *Microchelonus* species TOBIAS (1995: 39) created the subgenus *Parachelonus* within the genus *Microchelonus* SZÉPLIGETI. Furthermore, I accept the taxonomic ar-

rangement presented by TOBIAS (l. c.) assigning the *Microchelonus* species to three subgenera (*Parachelonus* TOBIAS, *Stylochelonus* HELLÉN, *Microchelonus* s. str.), the majority of the species belong to the subgenus *Microchelonus* s. str.

2. *M. gravenhorstii* stands nearest to *M. fenestratus* (NEES, 1816) (Europe) and the females are distinguished by the features as follows (male of *M. fenestratus* unknown so far):

1 (2) Temple, vertex and occiput transversely and less finely striate, eye in dorsal view twice as long as temple (Fig. 1). Antenna with 26–29 antennomeres (♂: with 29 antennomeres). Pterostigma 2.1–2.3(–2.7) times (♂: 2.3–2.9 times) as long as wide and issuing radial vein less distally from its middle, *r1* usually as long as *r2*, metacarp along radial cell as long as pterostigma (Fig. 3). In lateral view hind end of carapace less rounded (Fig. 5, see arrow), in ventral view carapace slightly less incurved (Fig. 6) (♂: somewhat more incurved, Fig. 13). Fore and middle femora yellow or middle femur more or less with brownish to blackish suffusion. ♀: 3.7–4 mm (♂: 3.9–4 mm) *M. gravenhorstii* (NEES, 1816)



Figs 1–10. *Microchelonus gravenhorstii* (NEES) (1–6: holotype ♀): 1 = head in dorsal view, 2 = head in lateral view, 3 = distal part of right fore wing, 4 = carapace in dorsal view with its sculpture on its right half, 5 = carapace in lateral view, 6 = carapace in ventral view, 7 = female temple in dorsal view, 8 = male head in dorsal view, 9 = posterior end of male carapace, 10 = hind end of female carapace in lateral view

2 (1) Temple, vertex and occiput transversely and finely striate, eye in dorsal view somewhat longer than temple (Fig. 15). Antenna with 16 antennomeres. Pterostigma 2.6–2.8 times as long as wide and issuing radial vein more distally from its middle, *r2* usually somewhat longer than *r1*, metacarp along radial cell shorter than pterostigma (Fig. 16). In lateral view hind end of carapace rounded (Fig. 17, see arrow); in ventral view carapace slightly more incurved (Fig. 18). Fore femur blackish to black and apically yellow, middle femur blackish to black. ♀: 3.5–4 mm

M. fenestratus (NEES, 1816)

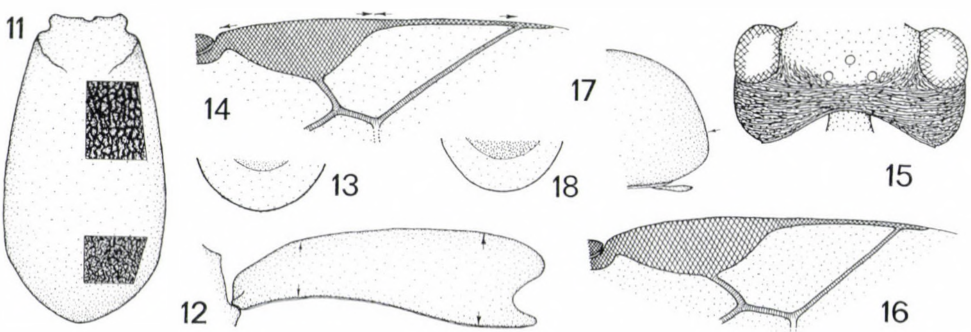
Microchelonus (Microchelonus) fenestratus (NEES, 1816)

Sigalphus fenestratus NEES, 1816: Mag. Ges. Naturf. Fr. Berlin 7 (1813): 269 ♂♀ (syntype series destroyed), type localities: "Berolini... Silesia et Italia"; neotype ♀ (present designation) in Museum of Natural History, Wroclaw; examined.

Chelonus and *Microchelonus fenestratus* (NEES) Shenefelt 1973 10 (Brac. 6): 851 (*Chelonus*) and 885 (Microchelonus) (literature up to 1971).

Microchelonus fenestratus (NEES): PAPP 1971: 83; TOBIAS 1986: 326.

Designation of the neotype of *Sigalphus fenestratus* NEES: "Bi." (?=Berolini, first label with GRAVENHORST's handwriting) – "C. fenestrator N.v.E." (second blue label with (?)L. GRAVENHORST's handwriting; the species name *fenestrator* is a slip of pen instead of *fenestratus*) – "48. Chelonus fenestratus N." (third label with handwriting with pencil) – fourth label is the neotype card, fifth label is with the actual name, *Microchelonus fenestratus* NEES, given by me.



Figs 11–18. 11–14. *Microchelonus gravenhorstii* (NEES): 11 = male carapace in dorsal view, 12 = male carapace in lateral view, 13 = hind end of male carapace in ventral view, 14 = distal part of female right fore wing. – 15–18. *Microchelonus fenestratus* (NEES) ♀: 15 = head in dorsal view, 16 = distal part of right fore wing, 17 = hind end of carapace in lateral view, 18 = hind end of carapace in ventral view

Taxonomic remark. – The designation of the neotype was necessary owing to the several *Microchelonus* species (*M. belokobylskij* TOBIAS, 1984; *M. gravenhorstii* [NEES, 1816]; *M. longipes* TOBIAS, 1984; *M. subfenestratus* TOBIAS, 1984) more or less related or resemble to *M. fenestratus*.

Microchelonus (Parachelonus) nigritulus (DAHLBOM) ♂ ♀ , **comb. n.** (Figs 19–27)

Chelonus nigritulus DAHLBOM, 1833: Kön. svenska VetenskAkad. Handl. 3 (1832): 161 ♂ (syntype series: 2 ♂♂), type locality: "Skåne... Esperöd" (Sweden), lectotype ♂ (present designation) in Museum of Zoology, Lund; examined. – SHENEFELT 1973: 89 (literature up to 1940).

Material examined: 2 ♂♂ syntypes and 2 ♀♀ + 1 ♂ specimens.

Designation of the lectotype ♂ (present designation): "C. nigritulus D. v. a." (= *Chelonus nigritulus* DAHLBOM var. a; first label with handwriting) – second label is with the locality name (Sweden, Skåne, Esperöd) adopted after DAHLBOM (1833: 161) and written by me; the third label is my lectotype card with red frame. – Designation of the paralectotype ♂ (present designation): "Prob. nigritulus ♂ var. b." (first label with W. R. M. de V. GRAHAM's handwriting) – second label is similar to that of the lectotype; third label is my paralectotype card. Remark: the paralectotype specimen actually represents the species *M. contractus* (NEES) and I name it so (fourth label). – 1 ♀ (without type status): "Almost certainly the *E. nigritulus* MWR.G. 1951)" (first label with M. W. R. de V. GRAHAM's handwriting in 1951) – "Sweden" (second label, printed, testified and attached by me). The specimen actually represents the species *M. nigritulus* corresponding to the postulated remark by GRAHAM and I named it accordingly (third label) (remark: ovipositor apparatus damaged, broken basally).

New localities – 1. 1 ♂: Hungary, Csomád, 27 May 1982, leg. J. PAPP. 2. 1 ♀: Germany, Umgebung Berlin, Biesenthal, 9 August 1964, leg. J. OEHLKE.

Description of the male lectotype. – Body 2.6 mm long. Head in dorsal view (Fig. 19) transverse, twice as broad as long, temple constricted and one-third shorter than eye. Ocelli small and round, POL : OD : OOL as 8 : 3 : 8. Eye in lateral view (Fig. 20) distinctly twice as high as wide, temple behind eye broader than eye. Malar space one-quarter longer than basal width of mandible. Face just less than twice as wide as high, inner margin of eyes parallel; clypeus clearly less wide than face, somewhat more than twice as wide as high; distance between tentorial pits one-third longer than distance between pit and lowest margin of eye. Face concentrically and upwards, head above (frons + vertex) rather transversely, temple and cheek rather longitudinally with dense rugulo-striation, dull; clypeus almost smooth and shiny. – Antenna shorter than body, as long as head, mesosoma and half carapace combined, with 18 antennomeres. First flagellomere twice as long as broad apically, further flagellomeres indistinctly shortening and attenuating so that penultimate flagellomere 1.2 times as long as broad.

Mesosoma in lateral view 1.45 times as long as high. Mesonotum in lateral view projecting anteriorly similar to that of *M. microphthalmus* WESMAEL (Fig. 21, see arrow). Notaulix distinct by somewhat roughened sculpture of mesonotum. Propodeum latero-medially with a pair of tubercules. Mesosoma rugose, propodeum on anterior or horizontal part roughly rugose and on its posterior or vertical part with carinae radiating around lunule. – Hind femur 3.75 times as long as broad medially. Hind tibia just longer than hind tarsus; pair of spurs of hind tibia almost equal in length, inner spur half as long as basitarsus. Hind basitarsus slightly longer than tarsomeres 2–3.

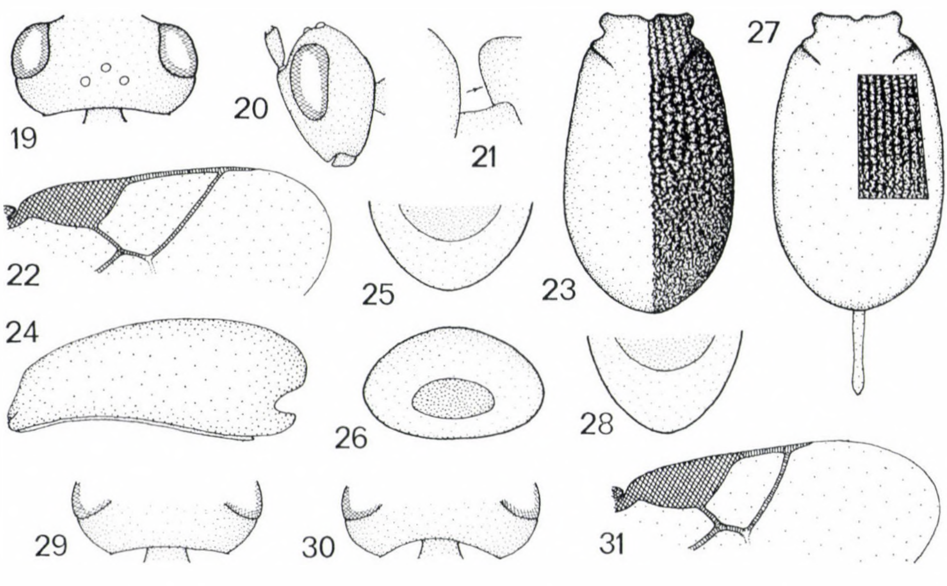
Fore wing one-fifth shorter than body. Pterostigma (Fig. 22) 2.3 times as long as wide, issuing radial vein distally from its middle, metacarp just longer than pterostigma, radial cell along metacarp 0.79 times as long as pterostigma, *r1* somewhat longer than *r2*, *r3* straight and ending far before tip of wing.

Carapace in dorsal view (Fig. 23) 1.7 times as long as broad medially, as long as mesosoma and half of head combined; in lateral view (Fig. 24) 2.5–2.6 times as long as high behind; in ventral view apically incurved (Fig. 25), i.e. ventral cavity somewhat shorter than carapace itself. Carapace longitudinally rugo-rugulose, sculpture weakening on its hind end; pair of keels distinct, short and converging (Fig. 23). Apical foramen elliptic, 2.2 times as wide as high (Fig. 26).

Body black, carapace anteriorly brownish (fading?). Mandible yellowish brown, palpi brownish. Antenna brown to brownish (fading?). Tegula dark brown to brown. Coxae and trochanters dark brown, hind femur brown, otherwise legs brownish with yellowish suffusion. Wings subhyaline (or faintly fumous), pterostigma opaque brownish, veins proximally opaque yellowish and distally brownish.

Variability of the morphological features of the male (1 ♂). – Body 3 mm long. Head in dorsal view 2.16 times as broad as long. Antenna with 20 antennomeres, first flagellomere 2.6 times and penultimate flagellomere 1.42 times as long as broad apically. Mesosoma in lateral view 1.46 times as long as high. Hind femur 3.66 times as long as broad. Carapace in dorsal view 1.74 times as long as broad medially, its longitudinal striate element somewhat more distinct (cf. Fig. 27). Apical foramen less elliptic, 1.77 times as wide as high. Body black, legs black to brownish black, fore tibia yellowish brown. Palpi blackish brown.

♀. Similar to the male. Body 2.2 mm long. Head in dorsal view transverse, 2.1 times as broad as long, temple 0.7 times as long as eye. Antenna with 16 antennomeres, first flagellomere 2.5 times and penultimate flagellomere 1.5 times as long as broad apically. Pterostigma 2.25 times



Figs 19–31. 19–27. *Microchelonus nigritulus* (DAHLBOM): 19 = head in dorsal view, 20 = head in lateral view, 21 = anterior part of mesonotum in lateral view (see arrow), 22 = distal part of right fore wing, 23 = male carapace in dorsal view, 24 = male carapace in lateral view, 25 = posterior end of male carapace in ventral view, 26 = posterior end of male carapace with foramen in frontal view, 27 = female carapace in dorsal view with an indication of its sculpture. – 28–29. *Microchelonus vulcaniellae* TOBIAS: 28 = posterior end of carapace in ventral view, 29 = temple in dorsal view. – 30–31. *Microchelonus subcontractus* (ABDINBEKOVA): 30 = temple in dorsal view, 31 = distal part of right fore wing

as long as wide, radial cell along metacarp 0.8 times as long as pterostigma. Hind femur 3.7 times as long as broad medially. Carapace in dorsal view 1.76 times as long as broad medially, its longitudinal striation more distinct (Fig. 27). Ovipositor sheath (in ventro-lateral view) as long as hind tarsomeres 1–3.

Host unknown.

Distribution: Sweden, Germany, Hungary.

M. nigritulus (DAHLBOM) stands nearest to *M. subcontractus* (ABDINBEKOVA), *M. vulcaniellae* TOBIAS and *M. brevis* (TOBIAS), their specific distinction is disclosed in the key as follows:

1 (6) Mesosoma in lateral view 1.4–1.5(–1.6) times as long as high (♀ ♂).

2 (3) Carapace behind distinctly incurved ventrally, i.e. apically incurved part about as long as basitarsus of hind leg (Fig. 28) or ventral opening of carapace clearly shorter than carapace itself. Temple in dorsal view strongly rounded (Fig. 29). Radial cell along metacarp 0.5–0.65 times as long as pterostigma, *r2* more or less longer than *r1*. Carapace either entirely black (♂) or latero-basally with a pair of (small) yellow(ish) spots (♀ ♂). 2.6–3 mm. – Crimea, Hungary *M. vulcaniellae* TOBIAS, 1990

3 (2) Carapace behind at most weakly incurved ventrally, i.e. apically incurved part about as long as second tarsomere of hind tarsus, or ventral opening of carapace nearly as long as carapace itself.

4 (5) Flagellomeres short, first flagellomere twice (♀ ♂) and penultimate flagellomere 1.2 times (♀) or 1.25 times (♂) as long as broad apically; antenna with 18–20 antennomeres (♂). Radial cell along metacarp 0.79 times as long as pterostigma, *r1* somewhat longer than *r2* (Fig. 22). Inner spur of hind tibia half as long as basitarsus. Head in dorsal view (Fig. 19) twice as broad as long, temple constricted, i.e. one-third shorter than eye and occiput weakly excavated. ♀: 2.2 mm, ♂: 2.6 mm. – Sweden, Germany, Hungary *M. nigritulus* (DAHLBOM), 1833

5 (4) Flagellomeres long, first flagellomere 2.8–3 times (♀) or three times (♂) and penultimate flagellomere 1.25–1.3 times (♀) or 1.5–1.8(2) times (♂) as long as broad apically. Radial cell along metacarp 0.5–0.6 times as long as pterostigma, *r1* usually shorter than (to at most as long as) *r2* (Fig. 31). Inner spur of hind tibia somewhat more than half as long as basitarsus. Head in dorsal view 2.1–2.2 times as broad as long, temple (Fig. 30) rounded to strongly rounded (less frequently constricted), one-fourth shorter than eye and occiput deeply excavated. ♀ ♂: 2.4–3(–4) mm. – Western Palaearctic Region *M. subcontractus* (ABDINBEKOVA, 1971)

6 (1) Mesosoma in lateral view hardly longer than high. Radial cell along metacarp 0.7 times as long as pterostigma, *r1* as long as *r2*. Flagellomeres short, first flagellomere 2.5 times as long as broad apically penultimate 3(–4) flagellomere cubic. Carapace weakly incurved ventrally. ♀: 3.8 mm. – Russia, Hungary, Italy

M. brevis (TOBIAS, 1976)

Taxonomic remarks. – 1. Since its description *Microchelonus nigritulus* (DAHLBOM) is a little known species. Both MARSHALL (1889: 367) and FAHRINGER (1934: 503) had enumerated it in the list of imperfectly described or in its taxonomic status uncertain species. TELENGA (1941) and TOBIAS (1986*a*) did not mention at all this species. HELLÉN (1923: 32) reported this species from Finland, however, I surmise, he has never examined the syntypes; HELLÉN (1958), in his paper of the *Chelonus* species of Finland, did not deal with this species disregarding its report in the past.

2. After TOBIAS (1995) I ranged *M. nigritulus* in the subgenus *Parachelonus* considering the female with 18 (and not 16) antennomeres and the male with a small apical foramen on carapace.

Microchelonus (Stylochelonus) pedator (DAHLBOM) ♀ ♂
(Figs 32–39)

Chelonus pedator DAHLBOM, 1833: Kön. svenska VetensAkad. Handl. 53 (1832): 161–162 "♂" = ♀, type locality: "Esperöd in Skåne" (Sweden), lectotype ♀ (and 1 ♂ paralectotype) in Museum of Zoology, Lund; examined.

Chelonella pedator (DAHLBOM): SZÉPLIGETI 1908 Annls hist.-nat. Mus. natn. hung. 6: 403 "pedator Thoms. ♂" (in key) and 404 ♂ of *Ch. secutor* MARSHALL.

Chelonus (Stylochelonus) pedator DAHLBOM: HELLÉN, 1958 Notul. ent. 38: 26 (in key) and 33 (description). SHENEFELT 1973: 872 (literature up to 1958).

Chelonus secutor MARSHALL, 1885: Trans. R. ent. Soc. Lond. p.116 (in key) and 135–136 (description) ♂, type locality: "Nunton, near Salisbury" (England), holotype ♂ in The Natural History Museum, London, synomized by HELLÉN 1958: 33; not examined.

Microchelonus (Stylochelonus) pedator (DAHLBOM): TOBIAS 1986*a*: 333 (comb. n. in key, subgeneric rank not given). TOBIAS 1995: 42 (type of the subgenus) and 42–43 (in key).

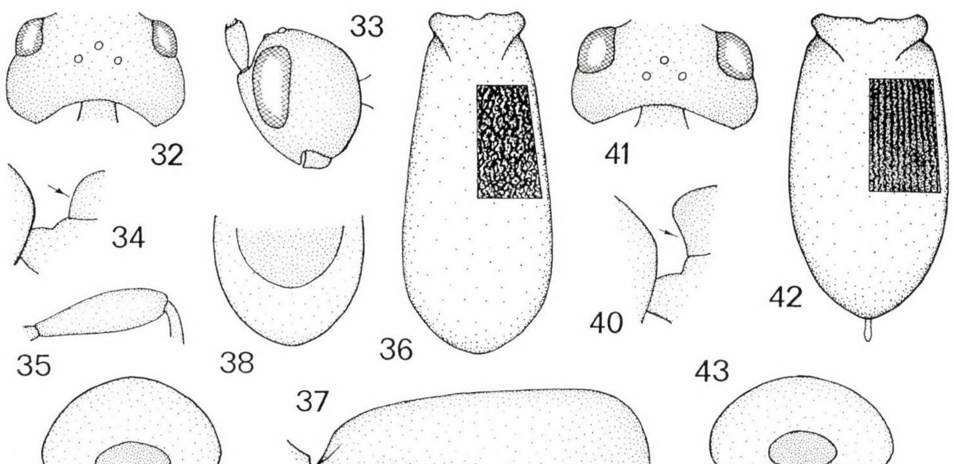
Lectotype ♀ designated by T. HUDDLESTON (London) in 1985 (in litt.) and its locality: Esperöd in Skåne, Sweden; the lectotype specimen is damaged: 1. Right antenna with 14 and left antenna with 15 antennomeres; 2. Distal half of left fore wing somewhat torn, together with distal third of hind wing somewhat shrivelled too; 3. Fore wing absent, right hind wing apically somewhat torn.

Designation of the paralectotype ♂: "ÖG." (="Lärketorp i Östergothland" in Sweden quotated after DAHLBOM l. c. p. 162) (first label, handwriting) – "♂" (second label, printed) – third label is my paralectotype card. The paralectotype is

seriously damaged: 1. Both antennae absent; 2. Middle and hind legs represented only by coxae + trochanters; 3. Distal part of wings torn, left hind wing absent.

Description of the lectotype ♀. – Body 3.6 mm long. Head in dorsal view (Fig. 32) less transverse, 1.63(–1.62) times as broad as long; temple bulged, i.e. head between temples broader than between eyes; temple 1.4 times as long as eye. Ocelli small and round, POL : OD : OOL as 12 : 3 : 12. Eye in lateral view (Fig. 33) 2.3 times as high as wide, temple strongly broadening behind eye, almost twice as wide as eye. Malar space as long as basal width of mandible. Face 1.52 times as wide as high, inner margin of eyes somewhat converging ventrally; clypeus clearly less wide than face, twice as wide as high; distance between tentorial pits twice as long as distance between pit and lowest margin of eye. Head rugulose-subrugulose and subshiny-faintly dull, clypeus laterally punctate and medially almost smooth, shiny. – Antenna shorter than body, about as long as head, mesosoma and half of carapace; with 23 antennomeres. First flagellomere three times as long as broad apically, further flagellomeres gradually shortening and from flagellomeres 18–20 somewhat attenuating so that penultimate flagellomere 1.5 times as long as broad.

Mesosoma in lateral view somewhat elongated, 1.7 times as long as high. Pronotum somewhat neck-like. Mesonotum in lateral view clearly declivous anteriorly (Fig. 34, see arrow). Notaulix distinct by somewhat crowded sculpture. Propodeum latero-medially with a pair of tubercules. Mesosoma rugose, propodeum areolate-rugose, mesonotum rugulose-rugose, scutellum laterally rugulose and medially punctate, interspaces shiny. Prescutellar furrow shallow, crenulate. – Hind femur (Fig. 35) 3.5 times as long as broad medially. Hind tibia somewhat longer than hind tarsus; pair of spurs of hind tibia unequal in length, inner spur just as long as half basitarsus, hind basitarsus as long as tarsomeres 2–4.



Figs 32–43. 32–39. *Microchelonus pedator* (DAHLBOM): 32 = head in dorsal view, 33 = head in lateral view, 34 = anterior part of mesonotum in lateral view (see arrow), 35 = hind femur, 36 = female carapace in dorsal view, 37 = female carapace in lateral view, 38 = posterior end of female carapace in ventral view, 39 = posterior end of male carapace in frontal view. – 40–43. *Microchelonus microphthalmus* (WESMAEL): 40 = anterior part of mesonotum in lateral view (see arrow), 41 = head in dorsal view, 42 = carapace in dorsal view with an indication of its sculpture, 43 = posterior end of male carapace with foramen in frontal view

Fore wing about one-sixth shorter than body. Pterostigma 3.2 times as long as wide, issuing radial vein distally from its middle, metacarp shorter than pterostigma, radial cell along metacarp 0.66 times as long as pterostigma, *r1* shorter than *r2*, *r3* straight and ending far before tip of wing.

Carapace in dorsal view long (Fig. 36), about as long as head and mesosoma combined, 2.3 times as long as broad behind, clearly broadening antero-posteriorly; in lateral view (Fig. 37) 3.2 times as long as high behind; in ventral view apically incurved (Fig. 38), i.e. ventral opening shorter than carapace itself. Carapace longitudinally rugose (Fig. 36), basally with striate elements, pair of basal keels short and less distinct. Ovipositor sheath very short.

Body black. Mandible rusty, palpi light brown, antenna black. Tegula black. Legs reddish yellow, coxae and first trochanters black(ish), tarsi blackish fumous. Wings almost hyaline, pterostigma brownish, veins proximally opaque yellowish and distally opaque light brownish.

Variability of the morphological features of the females (5 ♀♀). – Body 3.5–4 mm long (3.5: 1 ♀, 3.8: 1 ♀, 3.9: 1, 4: 1 ♀). Head in dorsal view transverse, 1.58–1.69 times as broad as long (1.58: 1 ♀, 1.6: 1 ♀, 1.65: 1 ♀; 1.67: 1 ♀, 1.69: 1 ♀). Antenna with 21–23 antennomeres (21: 2 ♀♀; 22: 2 ♀♀, 23: 1 ♀); penultimate flagellomere 1.55–1.75 times as long as broad (1.55: 2 ♀♀, 1.62: 2 ♀♀, 1.75: 1 ♀). Hind femur 3–3.2 times as long as broad (3: 1 ♀, 3.1: 1 ♀; 3.2: 3 ♀♀). Radial cell along metacarp 0.6–0.71 times as long as pterostigma (0.6: 1 ♀; 0.66: 2 ♀♀, 0.71: 2 ♀♀). Carapace in dorsal view 2.1–2.38 times as long as broad behind (2.1: 1 ♀, 2.12: 1 ♀, 2.19: 1 ♀, 2.33: 1 ♀, 2.38: 1 ♀). Legs partly black, i.e. basal half of fore femur together with entire middle and hind femora black.

♂. Similar to the female (4 ♂♂). – Body 3.3–4 mm long (3.3: 1 ♂; 3.4: 1 ♂, 3.9: 1 ♂, 4: 1 ♂). Head in dorsal view less transverse, 1.59–1.73 times as broad as long (1.59: 1 ♂, 1.64: 1 ♂, 1.71: 1 ♂, 1.73: 1 ♂). Antenna with 24–26 antennomeres (24: 2 ♂♂, 25: 1 ♂; 26: 1 ♂); penultimate flagellomere 1.42–1.75 times as long as broad (1.42: 1 ♂; 1.6: 1 ♂, 1.75: 2 ♂♂). Hind femur 3.1–3.3 times as long as broad medially (3.1: 1 ♂, 3.2 : 2 ♂♂; 3.3: 1 ♂). Radial cell along metacarp 0.62–0.77 times as long as pterostigma (0.62: 1 ♂, 0.66: 2 ♂♂, 0.77: 1 ♂). Carapace in dorsal view 2.1–2.2 times as long as broad behind (2.1: 3 ♂♂; 2.2: 1 ♂). Apical foramen of carapace small, elliptic, its horizontal width equal to length of hind tarsomeres 2–3 (Fig. 39) or 2.4–2.8 times as wide as high. Legs either reddish yellow (like those of lectotype) or partly black (like those of females).

Host: HELLÉN (1958: 33) reported the tortricid species *Aphelia paleana* HÜBNER (Lepidoptera) as host, the contribution, however, needs a confirmation.

Distribution: Sweden, Finland, Denmark, Russia, Bulgaria, Slovakia, Bosnia-Herzegovina; a rare species.

Considering the form of head in dorsal view with its bulging temple *M. pedator* is allied with *M. microphthalmus* (WESMAEL, 1838), the distinctive specific features between the two forms are disclosed in the following key:

1 (2) Mesonotum in lateral view (Fig. 34) clearly declivous anteriorly (♂ ♀). Head in dorsal view (Fig. 32) less transverse, 1.58–1.69 times (♀) and 1.59–1.73 times (♂) as broad as long, eye always shorter than temple. Carapace in dorsal view 2.1–2.35 times (♂ ♀) as long as broad behind, clearly broadening posteriorly, longitudinally rugose (Fig. 36); apical foramen of male carapace more elliptic (Fig. 39). Wings almost hyaline. ♀: 3–4 mm, ♂: 3.3–4 mm ..... *M. pedator* (DAHLBOM, 1838)

2 (1) Mesonotum in lateral view (Fig. 40) projecting and thus concave anteriorly (♂ ♀). Head in dorsal view (Fig. 41) transverse, 1.8–2.1 times as broad as long, eye about as long as temple (♂ ♀). Carapace in dorsal view 1.9–2.1

times as long as broad medially, not broadening posteriorly, longitudinally rugose-striate (Fig. 42); apical foramen of male carapace less elliptic (Fig. 43). Wings subhyaline to fumous. ♀: 3.7–4 mm, ♂: 3.5–4 mm

M. microphthalmus (WESMAEL, 1838)

Taxonomic remark. – The species was originally placed in the genus *Chelonus* JURINE. FAHRINGER (1934: 418 and 426 in keys, 459 redescription) was the first who had transferred this species to the subgenus *Chelonella* SZÉPLIGETI, 1908, later was emendated to generic rank by TELENGA (1941: 281 and 302; it seems reasonable to point out that TELENGA knew only the male sex of *M. pedator*). HELLÉN (1958: 33), surprisingly, created a new subgenus *Stylochelonus* for *pedator* DAHLBOM and placed it in the genus *Chelonus*. In 1951 MUESEBECK & WALKLEY (see in SHENEFELT 1973: 873) recognized that *Chelonella* is congeneric with *Microchelonus* sen. syn. TOBIAS (1986*a*: 311) pointed out that from among the members of *Microchelonus* (counting about hundred species in the Palaearctic Region) several are deviating, i.e. transitional to the genus *Chelonus* considering their features characteristic to the sexes (♀: antenna with more than 16 flagellomeres or ♂: carapace apically without a foramen). Nevertheless, though the number of the deviating *Microchelonus* species is relatively high, I consider the taxon *Microchelonus* as a valid genus closely related to *Chelonus*. First, as a consequence of this taxonomic concept, TOBIAS (1986*a*: 311 and 333) ranged the species *pedator* in the genus *Microchelonus*. Nine years later TOBIAS (1995: 39, 42–44) accepted the subgenus *Stylochelonus* HELLÉN and ranged the *Microchelonus* species in three subgenera: *Microchelonus* s. str., *Parachelonus* TOBIAS, *Stylochelonus* HELLÉN).

Schizoprymnus pullatus (DAHLBOM) ♂ ♀, **comb. n.**
(Figs 44–54)

Chelonus pullatus DAHLBOM, 1833: Kön. svenska VetenskAkad. Handl. 3 (1832): 163 ♂ ♀ (syntype series: 1 ♀ + 3 ♂♂), type locality: "Säteriet Bönstrop i Skåne" (Sweden), lectotype ♂ in Museum of Zoology, Lund; examined.

Triaspis (Triaspis) pullatus (DAHLBOM): FAHRINGER 1934 Opusc. bracon. Pal. Reg. 2: 373 (in key) and 401(–402, redescription) ♀♂ comb. n. TELENGA 1941: Faune de l'URSS, Insectes Hymenoptères Braconidae 5(3): 337 (in key) and 341 (redescription) ♀ ♂. SHENEFELT 1970: 294 (literature up to 1953).

Sigalphus rufipes HERRICH-SCHÄFFER, 1838: Faunae Insect. Germ. 153, 11 ♀ ♂ (in key and description + coloured figure), type locality: (?)Germany, syntype series lost (or destroyed), **syn. n.**

Triaspis (Schizoprymnus) rufipes (HERRICH-SCHÄFFER): Šnoflák 1953 Acta Entom. Mus. Natn. Pragae 28 (417) (1952): 300 (in key) and 369(–371, redescription) comb. n.

Schizoprymnus rufipes (HERRICH-SCHÄFFER): SHENEFELT 1970: 280 (as valid species, comb. n. and literature up to 1953). TOBIAS 1986*a* Key to the Insects of the European Part of the USSR, Hym. Braconidae 3 (4): 180 (in key as valid species, in Russian).

Sigalphus globosus SZÉPLIGETI, 1898: Természetrajzi Füzetek 21: 384 (in Hungarian) and 397 (in German) ♀ (syntype series: 3 ♀♀), type locality: Pilismarót (Hungary), lectotype ♀ (and 2 ♀ paralectotypes) in Magyar Természettudományi Múzeum, Budapest; examined and **syn. n.**

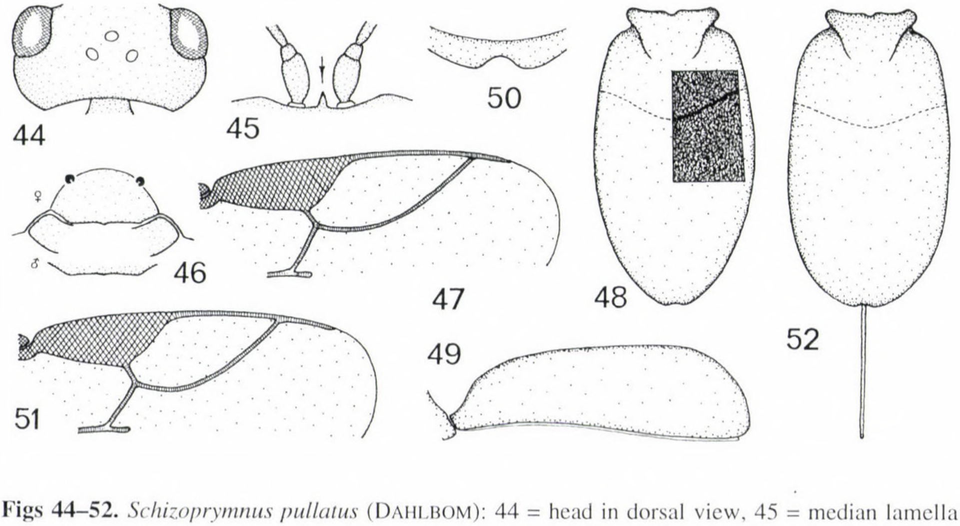
Type material examined: syntype series 3 ♂♂ + 1 ♀, of which 2 ♂♂ + 1 ♀ represent *S. pullatus* (DAHLBOM) and 1 ♂ represents *S. opacus* (THOMSON).

Designation of the lectotype ♂: "C. pullatus D. ♀." (♀ = ♂, first label with handwriting) – "Sweden" (printed) "Skåne Bjönstorp" (my handwriting, second label) – third label is my lectotype card and fourth label is with the actual name *Schizoprymnus pullatus* given by me.

Designation of the paralectotypes (1 ♀ + 2 ♂♂): "C. pullatus ♂" (2 ♂♂) and "C. pullatus ♀" (1 ♀) (first label) – second label is with the locality name as in the lectotype – third label is my paralectotype card – fourth label is with the actual names *S. pullatus* (DAHLBOM) (1 ♀ + 1 ♂) and *S. opacus* (THOMSON) (1 ♂) given by me.

Description of the lectotype ♂. – Body 3.5 mm long. Head in dorsal view (Fig. 44) transverse, 1.9 times as broad as long, eye about as long as temple, latter rounded, occiput weakly excavated. Median lamella between scapes low, about as high as pedicel (Fig. 45, see arrow). Ocelli small and elliptic, POL : OD : OOL as 9 : 4 : 10. Face three times as wide as high, inner margin of eyes parallel. Tentorial pits about one-third nearer to each other than to lowest margin of eye. Clypeus (Fig. 46) less wide than face, twice as wide as high, medially faintly pointed. Malar space somewhat longer than basal width of mandible. Face, clypeus and cheek punctate, interspaces shiny, frons rugose, otherwise head polished. – Antenna about one-fifth shorter than body, with 21 antennomeres. First flagellomere three times and penultimate flagellomere twice as long as broad.

Mesosoma in lateral view 1.55 times as long as high. Notaulix distinct and finely crenulate. Pecoxal suture (=sternaulix) rather wide and rugose. Pronotum strio-rugose, propodeum rugose, otherwise mesosoma polished with disperse fine punctures. – Hind femur 3.5 times as long as



Figs 44–52. *Schizoprymnus pullatus* (DAHLBOM): 44 = head in dorsal view, 45 = median lamella (see arrow) between scapes in dorsal view of head, 46 = female clypeus and lower margin of male clypeus, 47 = distal part of male right fore wing, 48 = male carapace in dorsal view with an indication of its sculpture, 49= male carapace in lateral view, 50 = posterior end of male carapace in frontal view, 51 = distal part of female right fore wing, 52 = female carapace in dorsal view

broad medially. Hind tibia somewhat longer than hind tarsus; hind basitarsus as long as tarsomeres 2–3 + half of 4.

Fore wing shorter than body. Pterostigma (Fig. 47) 2.7 times as long as wide, issuing radial vein distally from its middle, *r1* oblique to fore margin of pterostigma and less than half as long as width of pterostigma, *r2* ending far before tip of wing; radial cell along metacarp just shorter than length of pterostigma; second section of metacarp twice as long as *r1*, distal end of metacarp approaching tip of wing.

Carapace in dorsal view (Fig. 48) 1.77 times as long as broad medially, rugo-rugulose, first suture faintly distinct; in lateral view (Fig. 49) three times as long as high about medially, its upper outline moderately convex; in ventral view apically not incurved, i.e. ventral aperture as long as carapace itself. Carapace apically moderately emarginate (Fig. 50).

Body black. Palpi reddish yellow to brownish, tegula reddish yellow. Antenna blackish, scape, pedicel and flagellomeres 1–3(–4) with rusty suffusion, rest of flagellum blackish. Legs reddish yellow, coxae, trochanters brown, femora basally, tibiae distally and tarsi entirely brownish. Wings subhyaline, pterostigma and veins opaque brownish.

Variable features of the males (2 ♂ paratypes + several male specimens). – Body 2.3–3.5 mm, usually 3.1–3.4 mm, long. Head in dorsal view (1.7–)1.8–1.9 times as broad as long. Antenna with 21–24 antennomeres. Hind femur 3.2–3.6 times, usually 3.3–3.5 times, as long as broad medially. Pterostigma either as long as or somewhat longer than radial cell along metacarp. Carapace in dorsal view 1.7–1.8 times as long as broad medially. Antenna proximally more or less reddish to reddish yellow.

Description of the paralectotype ♀ and 35 ♀♀ + 22 ♂♂ specimens. – Similar to the male lectotype. Body 2.3–3.6 mm, usually 2.9–3.3 mm, long. Head in dorsal view 1.8–1.95 times, usually 1.8–1.9 times, as broad as long, eye as long as temple (minute deviations feasible). Lower margin of clypeus faintly pointed at its middle (Fig. 46). Antenna with 22–29, usually 22–26, antennomeres; first flagellomere 2.9–3.2 times as long as broad, penultimate flagellomere subcubic to cubic or exceptionally 1.2–1.3 times as long as broad. Pterostigma 2.55–2.6 times as long as wide, radial cell along metacarp shorter than length of pterostigma (Fig. 51). Carapace in dorsal view 1.7–2 times, usually about 1.9 times, as long as broad medially, somewhat more belly than that of male (Fig. 52); in lateral view (Fig. 53) (2.7–)2.8 times as long as high medially. Carapace apically semicircularly emarginate (Fig. 54). Ovipositor sheath in ventro-lateral view as long as length of carapace, rarely more or less shorter than carapace, in dorso-lateral view (i.e. its surpassing part beyond carapace) about as long as half carapace or entire hind tarsus. Reddish yellow colour of antenna (scape, pedicel, flagellomeres 1–4) and legs usually more vivid than that of male.

Hosts: 1. (after Glowacki 1953: 11–512): *Caterema terebella* ZINCKEN (Lep., Phycitidae) and *Cydia strobilella* LINNAEUS (Lep. Tortricidae); the two lepidopterous host data are in need of confirmation. – 2. *Mordellistena bicoloripilosa* ERMISCH and *M. weisei* SCHILSKY (Col., Mordellidae): new hosts; localities of the hosts: Tübingen (5 March 1994) and Breisach (8 April 1990) in Germany, respectively; hosts's foodplant: stem of *Artemisia vulgaris*; leg. et educ. CH. DENYS.

Distribution: Palaearctic Region.

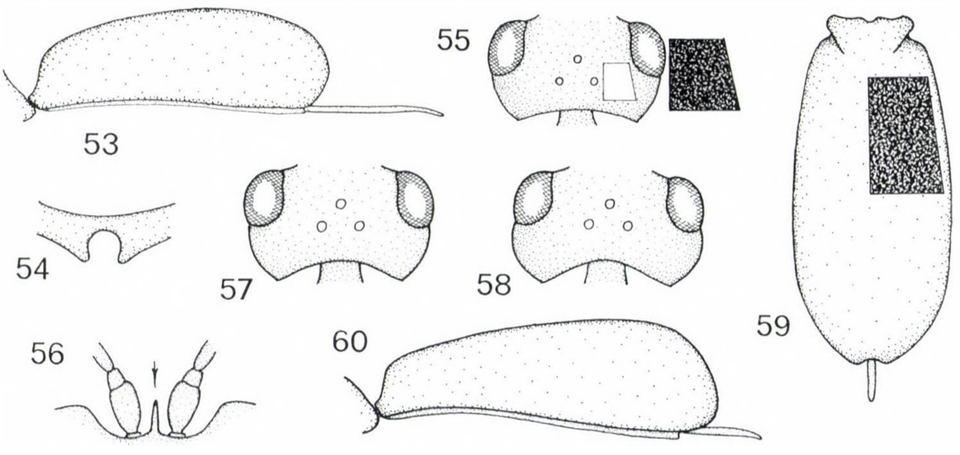
S. pullatus (DAHLBOM) stands nearest to the species *S. fumatus* (HERRICH-SCHÄFFER, 1838) (Germany, Hungary) and *S. luteipalpis* (ŠNOFLÁK, 1953) (Bohemia, Hungary) considering their similarly coloured body and legs and shape of body (head, carapace); their distinction is presented as follows:

1 (2) Temple in dorsal view (Fig. 55) close behind eye rounded, eye always more or less longer than temple. Antennal cavity deep, median lamella between scapes high, more or less higher than length of pedicel (Fig. 56, see arrow). Head above (vertex + frons) rugulose and subshiny to dull (Fig. 55). Hind

femur 4–4.5 times as long as broad. Otherwise similar to *S. pullatus*. 3.6–3.8 mm *S. fumatus* (HERRICH-SCHÄFFER)

2 (1) Temple in dorsal view (Figs 44, 57–58) rounded, close behind eye head between temples at least as broad as between eyes (Fig. 44), eye either as long as (♀♀) or somewhat longer than (♂♂) temple. Antennal cavity shallow (as usually), median lamella between scapes low, usually less (and at most as) high than (as) length of pedicel (Fig. 45, see arrow). Head above punctate. Hind femur 3.2–3.6 times as long as broad.

3 (4) Carapace in dorsal view (Fig. 59) 2.1–2.2 times as long as broad posteriorly, i.e. moderately broadening on its anterior two-thirds, rugose sculpture somewhat rougher than that of *S. pullatus*; in lateral view (Fig. 60) 2.9–3.1 times as long as high behind. Head in dorsal view between temples either as broad as or slightly broader than between eyes (Figs 57–58). Vertex (of head) usually more or less distinctly punctate, interspaces short and subshiny to dull. Ovipositor sheath in ventro-lateral view about half as long as carapace or about as long as hind femur. 3–4 mm *S. luteipalpis* (ŠNOFLÁK)



Figs 53–60. 53–54. *Schizoprymnus pullatus* (DAHLBOM): 53 = female carapace in lateral view, 54 = posterior end of female carapace in frontal view. – 55–56. *Schizoprymnus fumatus* (HERRICH-SCHÄFFER): 55 = head in dorsal view with an indication of its sculpture, 56 = median lamella (see arrow) between scapes in dorsal view of head. – 57–60. *Schizoprymnus luteipalpis* (ŠNOFLÁK): 57–58 = head in dorsal view, 59 = carapace in dorsal view with an indication of its sculpture, 60 = carapace in lateral view

4 (3) Carapace in dorsal view (Figs 48, 52) 1.7–1.95 times as long as broad medially, i.e. moderately broadening up to its middle, rugose sculpture somewhat finer than that of *S. luteipalpis*; in lateral view (Figs 49, 53) 2.6–3 times as long as high medially. Head in dorsal view (Fig. 44) between temples at most as broad as between eyes. Vertex (of head) finely and dispersely subpunctate, interspaces large and polished. Ovipositor sheath in ventrolateral view about as long as carapace. 2.3–3.5 mm

S. pullatus (DAHLBOM)

Taxonomic remark. – 1. First FAHRINGER (1934: 373 and 401) recognized that the species *S. pullatus* represents the genus *Triaspis* HALIDAY, 1835. This taxonomic position of *pullatus* was adopted by TELENGA (1941: 337 and 341) too. ŠNOFLÁK (1953) and TOBIAS (1986*a*) did not know this species, i.e. it has not been included in their monographs. Following modern conceptions in classifying the calyptine species it seems decidedly reasonable to assign *pullatus* to the genus *Schizoprymnus* FOERSTER, 1862.

2. The synonymization of *Sigalphus rufipes* HERRICH-SCHÄFFER and *Sigalphus globosus* SZÉPLIGETI with *Chelonus pullatus* DAHLBOM is based on the cross-checks of the description and coloured figure (of *S. rufipes*) as well as the description and type-series (of *S. globosus*) to the description and type series of the senior species, *Chelonus pullatus*.

* * *

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NEW NOCTUIDAE (LEPIDOPTERA) SPECIES FROM TAIWAN AND THE ADJACENT AREAS

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Descriptions of 23 new species and 4 new subspecies from Taiwan, the mainland of China, Thailand and Vietnam, with taxonomic notes of some less known Noctuidae taxa are given. With 187 figures.

Key words: Noctuidae, new taxa, Taiwan, Himalayan region

INTRODUCTION

The exploration of the Noctuidae fauna of Taiwan has been intensified during the last fifteen years and a considerable number of new, often endemic species have been discovered and described. The results of the these investigations made in the eighties, mostly by Japanese and Taiwanese specialists, were summarized in the book of CHANG (1991) and the Checklist of the Lepidoptera in Taiwan (SUGI *et al.*, in HEPPNER 1992); several recent articles describe results of subsequent studies.

The first results of the Hungarian lepidopterological expeditions to Taiwan were published recently, in connection with the taxonomic treatment of the Nepalese Noctuidae fauna (HREBLAY & RONKAY 1997). The present paper contains new information obtained from the 1996 expeditions, especially the new taxa of the early spring and the late autumnal fauna.

Abbreviations: MAK = Zoologisches Forschungsinstitut und Museum Alexander Koenig, Bonn; BMNH = The Natural History Museum, London (formerly British Museum, Natural History). The codes "HM" and "RL" in the numbers of the genital slides refer to the person who made the dissection of the specimen and the mounting of the genitalia; the letters "m" and "f" show the sex of the specimen; HM = HREBLAY, M.; RL = RONKAY, L.; m = male; f = female.

SYSTEMATIC PART

Plataplecta pulverosa taitungensis ssp. n.
(Figs 10, 11, 128)

Holotype: male, "TAIWAN, Prov. Taitung, 5 km NW of Lirao, 1760 m, 28.V.1995, 120°59'E, 23°13'N, leg. M. Hreblay & P. Stéger", slide No. HM7723 (coll. HREBLAY).

Paratypes: 2 m, 1 f, with the same data as the holotype (coll. HREBLAY).
Slide Nos HM7725 (male), HM7724 (female).

Diagnosis: the Taiwanese subspecies, *P. pulverosa taitungensis* differs from the nominate *P. p. pulverosa* (HAMPSON, 1909), in the evenly darker forewing and the paler grey and whitish rather than ochreous hindwing.

Description: wingspan 32–34 mm, length of forewing 14–16 mm. Head and thorax grey mixed with black and whitish hair-scales, abdomen paler, light grey; antennae of both sexes filiform. Forewing rather dark grey, wing pattern diffuse. Ante- and postmedian lines double, sinuous, filled with whitish-grey; terminal line represented by dark spots between veins. Orbicular and reniform stigmata indistinct, their filling somewhat paler than ground colour; claviform absent. Hindwing pale greyish, marginal suffusion relatively broad, transverse line narrow, diffuse.

Remarks: first record of the species from Taiwan (see SUGI 1979, 1992 and CHANG, 1991, WANG, 1995).

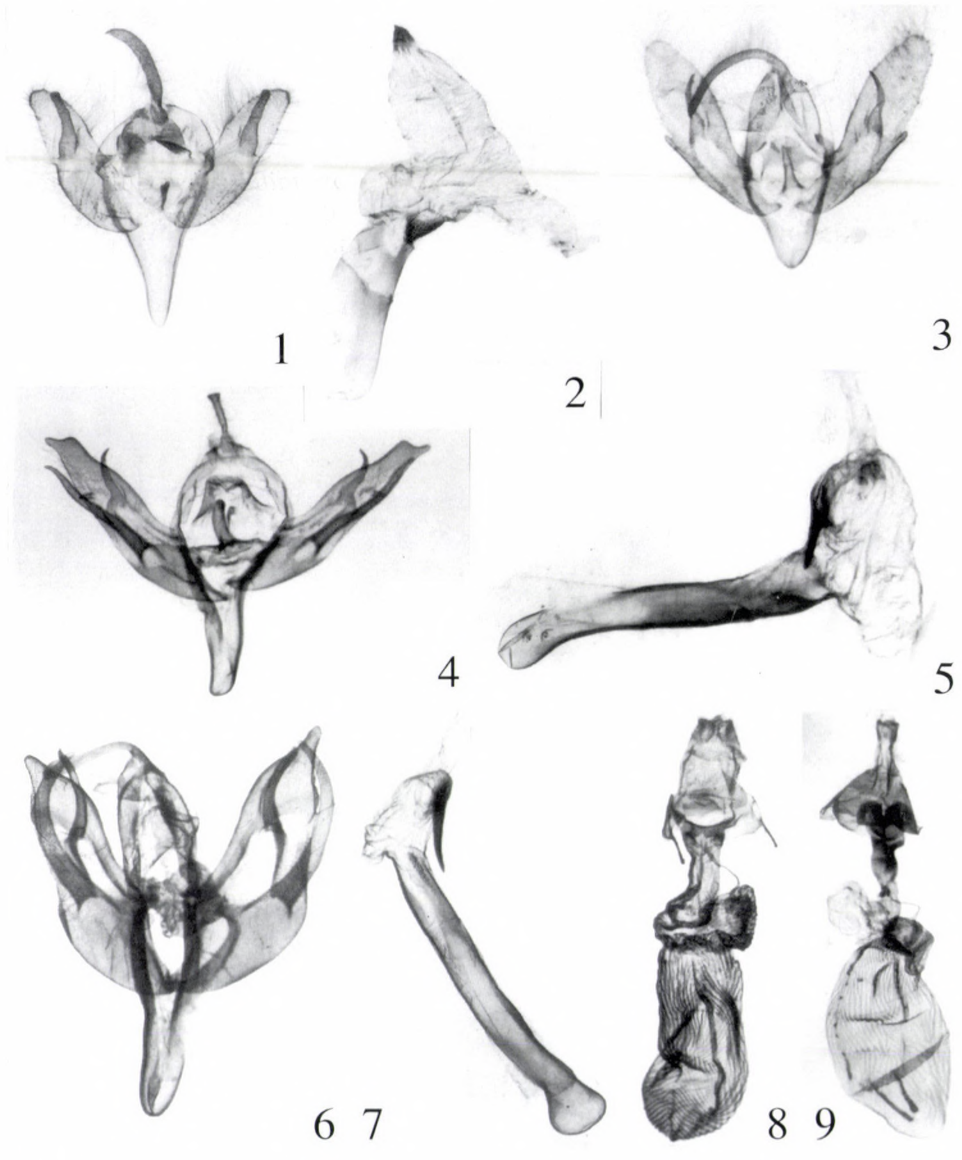
Hermonassa formontana sp. n.
(Figs 1, 2, 8, 124)

Holotype: male, "TAIWAN, Prov. Nantou, 5 km SW of Tayüling, 2900 m, 6. VIII. 1996, 121°17'E, 24°09'N, leg. T. Csővári & L. Mikus", slide No. HM9316 (coll. HREBLAY).

Paratypes: Taiwan. Prov. Kaohsiung: 2 m, 1 f, 10 km NW of Lirao, 2500 m, 30. V. 1995, 120°57'E, 23°17'N, leg. M. HREBLAY & P. STÉGER. Prov. Nantou: 1 f, 5 km SW of Tayüling, 2900 m, 19. X. 1995, 121°17'E, 24°09'N; 2 f, 3 km SW of Tsuifeng, 2100 m, 26–27. X. 1995, 121°10'E, 24°06'N, leg. T. CSŐVÁRI & P. STÉGER; 5 km SW of Tayuling, 2900 m, 6. VIII. 1996, 121°17'E, 24°09'N; 1 f, 3 km SW of Tsuifeng, 2100 m, 7. VIII. 1996, 121°10'E, 24°06'N; 13 m, 2 f, 7 km SW of Tayuling, 3000 m, 19. VIII. 1996, 121°16'E, 24°08'N, leg. T. CSŐVÁRI & L. MIKUS; 1 m, 2 f, Tayuling, 2550 m, 7–8. 10. 1996, leg. GY. FÁBIÁN & F. NEMES. Prov. Hualien: 2 m, 1 f, Kuanyuan, 2380 m, 11–12.X.1996, leg. GY. FÁBIÁN & F. NEMES. Prov. Miaoli: 15 m, 11 f, 49 km E of Tungshih, 2490 m, 8. VIII. 1996, 121°03'E, 24°19'N, leg. T. CSŐVÁRI & L. MIKUS. Prov. Taitung: 3 m, Hsiangyang, Police station, 2320 m, 25–26.X.1996; 1 f, Yakou, 2600 m, 1–3.XI.1996, leg. GY. FÁBIÁN & F. NEMES (coll. CSŐVÁRI, FÁBIÁN, HREBLAY).
Slide Nos HM7757, HM9319 (males), HM7758, HM9320 (females).

Diagnosis: as presently known, the genus *Hermonassa* WALKER, 1865 is represented in Taiwan, by five species, *H. inconstans* WILEMAN, 1914 (Figs 3, 125), *H. hemicyclia* PLANTE, 1994, *H. legraini* PLANTE, 1994, *H. formontana* sp.

n. and *H. plantei* sp. n., respectively. *H. formontana* sp. n. belongs to the *H. rufa* BOURSIN, 1968 species-group, its closest relatives are *H. consignata* (WALKER, 1865) and *H. corax* SUGI, 1995. It differs from *H. consignata* by its larger size and dark hindwings, from *H. corax* by its greenish, not dark brownish forewing



Figs 1–9. 1–2 = *Hermonassa formontana* sp. n., holotype; 3 = *H. inconstans* WILEMAN, 1914; 4–5 = *H. plantei* sp. n., holotype; 6–7 = *H. arenosa* (BUTLER, 1881); 8 = *H. formontana* sp. n., paratype; 9 = *Hermonassa plantei* sp. n., paratype

ground colour. The main specific features in the male genitalia of *H. formontana* are the presence of a small medial crest of the fultura inferior, the rather long uncus and vinculum. The size and position of the cornutus of the vesica is also different in the three related species as the cornutus of *H. corax* is larger, while that of *H. consignata* is smaller than in *H. formontana*; the cornutus is situated more distally in case of the new species than in both related taxa.

The other four Taiwanese species belong to other species groups. *H. hemicyclia* PLANTE, 1994 is a member of the *H. phenax* BOURSIN, 1968 group. This species has the forewing pattern somewhat similar to that of *H. formontana*, but is larger in size and the ground colour is dark brownish. *H. inconstans* WILEMAN, 1914, and the other two Taiwanese *Hermonassa* species (*H. legraini* PLANTE, 1994 and *H. plantei* sp. n.) are representatives of the *H. arenosa* (BUTLER, 1881) species group. *H. inconstans* resembles to *H. formontana* by its greenish ground colour, differing from the new species in the shortly bipectinated antenna of the males, the brownish-reddish marginal field and the less sharply marked, not black(ish) but greyish stigmata of the forewing; the last two taxa, *H. legraini* and *H. plantei* sp. n. are strongly dissimilar.

Description: wingspan 30–33 mm, length of forewing 14–15 mm. Head and thorax olive-green, collar and tegulae irrorated with some ochreous and black scales. Antennae of both sexes filiform; abdomen paler greyish. Forewing narrow, elongated, outer margin evenly arcuate. Ground colour olive-green, irrorated with black scales. Subbasal, ante- and postmedial crosslines double, sinuous, dark brownish, filled with ground colour; medial line diffuse. Stigmata evenly black, sharply defined, encircled with ochreous. Subterminal line sinuous, interrupted, consisting of dark, acute triangles, defined by a paler, ochreous outer shadow. Terminal line a row of black spots between veins. Hindwing shining greyish, veins and wide marginal field somewhat darker. Discal spot present, narrow, lunulate, terminal line absent. Underside of wings shining grey, discal spots present.

Male genitalia (Figs 1, 2): uncus long, slender, curved, apex pointed; tegumen low, wide, vinculum elongated, V-shaped. Fultura inferior a cordiform plate, with a small medial crest. Valva elongated, narrow, with almost parallel margins. Distal third tapering, with apex finely rounded, corona absent. Sacculus short, clavus reduced, saccular extension absent. Harpe strong, more or less straight, extending beyond costal margin; its tip rounded. Aedeagus cylindrical, carina with a short, weak lateral bar and a strongly dentated ventral plate. Vesica short, broadly tubular, with a large, subconical-sacculiform dorsal diverticulum, terminated in a short, pointed, bulbed cornutus.

Female genitalia (Fig. 8): ovipositor relatively short, weak, gonapophyses short. Ostium bursae calyculate, sclerotized, ductus bursae tubular, flattened, straight, relatively long. Cervix bursae small, conical, ribbed, corpus bursae large, saccate, membranous with strong wrinkles and with two (a short and a much longer) signa.

Hermonassa plantei sp. n.
(Figs 4, 5, 9, 127)

Holotype: male, "TAIWAN, Prov. Taitung, Hsiangyang, 2320 m, 2. XI. 1996, leg. Gy. Fábián & F. Nemes" slide No. RL5832 (coll. HREBLAY).

Paratypes: Taiwan. Prov. Taitung: 2 m, 3 f, Hsiangyang, 2320 m, 2.XI.1996, leg. GY. FÁBIÁN & F. NEMES (coll. FÁBIÁN); 1 f, 5 km NW of Lirao, 1760 m, 28.V.1995, 120°59'E, 23°13'N, leg. M. HREBLAY & P. STÉGER (coll. HREBLAY); 16 males, Yushan Mts, Yakou, above Hsiangyang, 2700 m, 7.VII.1997, leg. B. HERCZIG and S. T. KOVÁCS (coll. HERCZIG and KOVÁCS); 4 males and 1 female, Yushan Mts, Hsiangyang, 2200 m, 13–14.VI.1997; 2 males, above Liyuan, 1950 m, 15.VI.1997, leg. B. HERCZIG and L. RONKAY (coll. HNHM, HERCZIG, G. RONKAY).

Slide No. HM7733 (female).

Diagnosis: the new species is closely related to *H. legraini* PLANTE, 1994 (Fig. 126), and *H. arenosa* (BUTLER, 1881) (Figs 6, 7). It differs from the former in the larger size, more vivid, ochreous-pinkish colouration of the forewings with less lattice-like, much sharper dark pattern and much paler hindwings, from the latter by larger, broader wings, more ochreous-reddish, not grey-brownish ground colour. The male genitalia of the three species are similar in type but that of *H. plantei* are considerably larger than those of the allied taxa, the vinculum, the valvae and the saccular processi are much longer, the cucullus is shorter but broader, the cornutus of the vesica is significantly larger, the shape of the fultura inferior is different, etc.

Description: wingspan 38 mm, length of forewing 18 mm. Head and thorax dark red-brownish, mixed with ochreous, collar and tegulae marked finely with dark brown. Antennae filiform in both sexes; 2nd joint of palpi with fine, peaked lobe of hairs. Abdomen paler, ochreous-grey, dorsal crest absent. Forewing narrow, elongated, with apex finely pointed, outer margin evenly arcuate. Ground colour pale ochreous brown with fine pinkish-reddish shade, sparsely irrorated with darker grey-brown and blackish. Subbasal and antemedial crosslines broad, double, less sinuous, dark brown filled with ground colour, medial line a diffuse, grey-brownish shadow. Postmedial line rather indistinct, double, ochreous marked with blackish spots and darker grey-brown filling, subterminal continuous, less waved, dark grey-brown with larger, triangular costal patch. Stigmata present, sharply defined, relatively small, encircled with whitish-ochreous, filled with black(ish). Terminal line a row of small black spots, cilia ochreous brown with paler ochreous medial line. Hindwing shining whitish-ochreous, suffused with greyish-brown, veins and narrow marginals field darker. Discal spot present, narrow, lunulate, terminal line fine, dark brown, cilia ochreous with dark grey-brown medial stripe. Underside of wings shining whitish, inner area of forewing suffused with grey, costal parts of both wings strongly irrorated with dark ochreous, brown and grey. Discal spots, upper parts of transverse lines usually well-discernible, shadows of subterminal line and streak of submedial fold of forewing, a dark marginal streak of hindwing also present.

Male genitalia (Figs 4, 5): uncus short, slender, apically finely spatulate, tegumen wide, low, penicular lobes reduced. Fultura inferior sclerotized, a low, elliptical plate with a thick, huge apical process; vinculum very long, heavily sclerotized. Valva long, narrow, apically tapering into a ventral, pointed extension, apex rounded, cucullus very small, corona reduced. Sacculus short, strong, clavus reduced, saccular extension extremely long, acute, heavily sclerotized. Harpe strong, acute, slightly S-shaped. Aedeagus long, strong, cylindrical, carina with strong ventral plate. Vesica spacious, short, with a broad, sacculiform basal diverticulum ventrally and a large, bulbed terminal cornutus.

Female genitalia (Fig. 9): ovipositor short, conical with rounded tip. Ostium bursae large, bilobate, strongly sclerotized. Ductus bursae relatively long, narrow, flattened, distal part granulosely sclerotized, proximal part with a discoidal, rugulose diverticulum. Cervix bursae small, rounded, wrinkled, corpus bursae large, elliptical, membranous, with four narrow, interrupted signum-stripes.

Cerastis griseiorbis sp. n.
(Figs 16, 17, 130, 131)

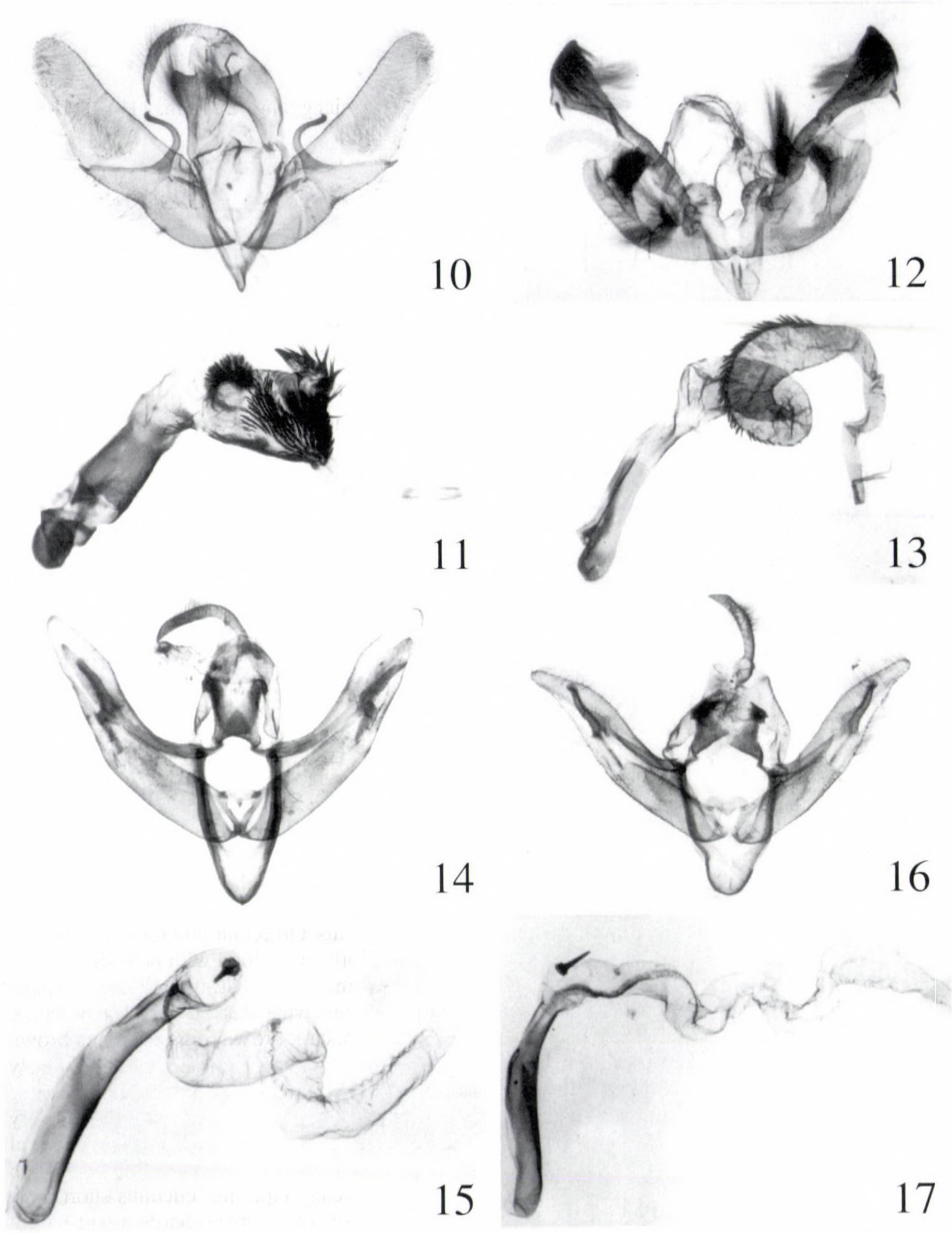
Holotype: male, "Taiwan, Prov. Taitung, 2 km E of Hsiangyang, 2200 m, 11–13.III.1996, leg. Gy. Fábián & L. Németh", slide No. RL5689 (coll. FÁBIÁN).

Paratypes: Taiwan. Prov. Taitung: 4 m, 1 f, with the same data as holotype. Prov. Kaohsiung: 2 m, 15 km NE of Taoyuan, 1850 m, 12.III.1996, leg. GY. FÁBIÁN & L. NÉMETH (coll. Mus. Univ. Sun-Yat Sen, Kaohsiung, FÁBIÁN, GYULAI, HERCZIG).
Slide No. RL5919 (female).

Diagnosis: the new species is closely related to *C. violetta* BOURSIN, 1955 (Figs 14, 15), representing its allopatric sibling species in Taiwan. *C. griseiorbis* is smaller in size with more gracile body, the forewing pattern is more expressed, although diffuse, the orbicular stigma is large, rounded, filled characteristically with pale grey. The male genitalia of the two species are easily distinguishable, the most conspicuous difference is in the length and coiling of the vesica: it is considerably longer the new species, with three full turnings while it has only two in *C. violetta*. The longitudinal sclerotized ribbon of *C. griseiorbis* is stronger, the last turning is broadened, the basal cornutus has smaller but more bulbed basal part. The clasping apparate of the new species differs from that of *C. violetta* by its smaller, narrower, more tapering valva, shorter, more wide-based, less straight harpe and smaller plates of fultura superior.

Description: wingspan 31–34 mm, length of forewing 14–16 mm. Head and thorax dark violaceous grey, mixed with dark chocolate-brown, frons and collar with whitish grey. Antennae of male finely ciliate, those of female filiform, abdomen slightly paler, more greyish, dorsal crest absent. Forewing relatively short, high triangular with apex acute, outer margin slightly concave below apex. Ground colour dark violaceous grey, costal part and medial area suffused partly with chocolate-brown. Wing pattern less sharply defined, ante- and postmedial crosslines double, sinuous, dark brown, medial line diffuse, narrow, shadow-like, subterminal obsolete, represented by its strong, dark, triangular costal patch and a few dark scales at tornus. Orbicular and reniform stigmata large, rounded, encircled by dark brown and a few whitish, orbicular filled with pale violaceous-grey, reniform with dark brown; claviform absent. Terminal line a row of tiny dark brown spots, cilia reddish grey. Hindwing greyish brown, marginal area somewhat darker, discal spot rather strong, lunulate, transverse line shadow-like. Terminal line fine, dark brown, cilia ochreous brown with darker outer half. Underside of wings whitish grey, forewing strongly, hindwing less intensely suffused with darker greyish brown, discal spots and transverse lines pale, diffuse.

Male genitalia (Figs 14, 15): uncus short, curved, tegumen low, broad, penicular lobes very small, prominent. Fultura inferior small, cordiform, fultura superior heavily sclerotized, medial plates flattened, broadly triangular, apical membrane covered densely with small spiculi on both sides; vinculum short but strong. Valva elongated, slender, apically tapering, cucullus short, narrow, finely rounded, corona reduced. Sacculus long, narrow, scarcely setose, harpe broad-based, flattened but folded along axis, apex truncated. Aedeagus long, tubular, finely arcuate, carina with two long ventro-lateral bars, one of them continuing in a very long, wrinkled, sclerotized ribbon terminated close to ductus ejaculatorius. Vesica tubular, very long, helicoid with three turnings, its walls membranous with fine scobination. Basal part with a small, semiglobular diverticulum, armed with a strong, thorn-like, bulbed cornutus.



Figs 10–17. 10–11 = *Plataplecta pulverosa taitungensis* ssp. n., holotype; 12–13 = *Polia mortua caeca* ssp. n., holotype; 14–15 = *Cerastis violetta* BOURSIN, 1955; 16–17 = *C. griseiorbis* sp. n., paratype

Female genitalia: ovipositor rather short,weak, gonapophyses short. Ostium bursae an U-shaped, sclerotized half-ring, ductus bursae flattened, short, posterior half with two sclerotized laminae, anterior part with strong, oblique, membranous wrinkles. Cervix bursae very long, membranous, helicoid with three full turnings, terminated in a recurved, slightly broadened sac. Corpus bursae elliptical-sacculiform, membranous with very fine scobination.

Polia mortua caeca ssp. n.
(Figs 12, 13, 132, 133)

Holotype: male, "TAIWAN, Prov. Nantou, 7 km SW of Tayüling, 3000 m, 19. VIII. 1996, 121°16'E, 24°08'N, leg. T. Csővári & L. Mikus", slide No. HM9351 (coll. HREBLAY).

Paratypes: Prov. Nantou: 2 m, 1 f, with the same data as the holotype; 2 f, 5 km SW of Tayuling, 2900 m, 6.VIII.1996, 121°17'E, 24°09'N, leg. T. CSŐVÁRI & L. MIKUS (coll. CSŐVÁRI, HREBLAY).

Diagnosis: the new subspecies differs from the nominate subspecies by its larger size and much darker hindwing. The underside of both wings is also uniformly dark, darker than that of *P. m. mortua* (STAUDINGER, 1888).

Description: wingspan 46–53 mm, length of forewing 23–25 mm. Head, thorax and forewing black with somewhat greyish shining, wing pattern the same as in the nominate subspecies. Hindwing uniformly dark blackish-grey, veins somewhat darker, discal spot small, indistinct or missing; base of cilia somewhat ochreous. Underside of both wings uniformly dark blackish grey.

The male genitalia (Figs 12, 13) are identical with those of the nominate subspecies.

Panolis pinicortex DRAUDT, 1950
(Figs 24, 137)

Type material examined: syntype female, "Hoengshan, (900 m), Provinz Hunan, China, 13. 3. 1933. H. Höne." (coll. MAK, Bonn); designated here as lectotype. Slide No. HM8997.

Description of the female genitalia (Fig. 24): ovipositor short, weak, subconical, with rounded tip, gonapophyses slender, rather short. Ostium bursae trapezoidal with arcuate caudal edge, lateral margins stronger. Posterior part of ductus bursae sclerotized, flattened, with heavily sclerotized lateral margins and a medio-lateral fold, anterior part weaker, scobinate, relatively short. Cervix bursae broad, short, helicoid, proximal part ribbed. Corpus bursae elliptical, membranous with stronger apical ribs, fundus bearing two short signa.

Panolis pinicortex exornata ssp. n.
P. variegata WILEMAN sensu CHANG (1991, partim.).
(Figs 18, 19, 25, 138, 139)

Holotype: male, Taiwan, Prov Miaoli, 49 km E of Tungshih, 2490 m, 23. III. 1996, 21°03'E, 24°19'N, leg. T. CSŐVÁRI & P. STÉGER (coll. HREBLAY).

Paratypes: Taiwan. Prov. Nantou: 2 m, 1 f, 3 km SW of Tsuifeng, 2100 m, 16.III., 27.III.1996, 121°10'E, 24°06'N, leg. T. CSŐVÁRI & P. STÉGER; 1 m, Meihsi, 21.I.1996. Prov. Kaoshiung: 2 m, 26m km SE of Taoyüan, 1370 m, 19. III. 1996, 120°52'E, 23°17'N, leg. T. CSŐVÁRI & P. STÉGER. Prov. Taitung: 1 m, 7 km N of Tupan, 500 m, 20. III. 1996, 120°52'E, 22°29'N, leg. T. CSŐVÁRI & P. STÉGER, 1 female, Hsiangyang, Police station, 2320 m, 29.IV.1997, leg. GY. FÁBIÁN & S. KOVÁCS (coll. CSŐVÁRI, FÁBIÁN, HREBLAY).

Slide Nos HM8746 (male), HM9741 (female).

Diagnosis: the Taiwanese populations differ from the nominotypical *P. pinicortex pinicortex* DRAUDT, 1950, by their darker colouration of both wings, especially of the hindwing. The male genitalia cannot be compared, due to the absence of the male syntype(s), the female genitalia are almost identical, the ostium bursae of the Taiwanese subspecies is somewhat smaller, weaker and the signa are longer.

Description: wingspan 37–40 mm, length of forewing 17–19 mm. Head and small, whitish-grey, palpi short, antennae of male finely ciliate. Thorax robust, collar, metathoracic tuft and tegulae more or less distinct, dark brick-red, marked with brown and whitish grey. Abdomen paler more ochreous-reddish, lateral ridges whitish. Forewing narrow, elongated, with apex finely rounded, scaling finely reticulate. Ground colour deep brick-red with intense cupreous gloss and fine, pale ash-grey irroration, especially in basal area. Wing pattern paler, whitish-ochreous, rather distinct. Crosslines sinuous, simple, antemedial line marked also by some greyish, subterminal with fine darker lines at outer side. Stigmata present, encircled with whitish, orbicular and claviform filled partly with pale grey. Terminal line indistinct, cilia as ground colour, striolate with ochreous. Hindwing shining, pale reddish-ochreous, veins, small, rounded discal spot and narrow, diffuse marginal suffusion darker red-brown; cilia white, spotted with reddish. Underside of both wings shining, light ochreous-pinkish, forewing with stronger deep reddish suffusion. Discal spots and remnants of transverse lines present but diffuse in both wings.

Male genitalia (Figs 18, 19): uncus short, narrow at base, distal half spatulate, triangular, with arcuate tip. Tegumen narrow, low, fultura inferior a simple, elongated, weakly sclerotized plate; vinculum strong, thick, V-shaped. Valva medium-long, distally slightly tapering; cucullus rounded, hairy, corona absent. Sacculus strong, rather short, setose, distal end forming a short process; clavus well-developed, rounded. Harpe sclerotized, strong, its basal plate broad, flattened, falcate, erected part relatively short, digitiform; ampulla straight, stick-like. Aedeagus cylindrical, straight, carina with a smooth dorsal and two dentated-serrate ventro-lateral bars. Vesica broadly tubular, recurved ventrally, medial part broadened, armed by a few tiny spinules in a small scobinate field. Proximal third with a very long, tubular diverticulum erected forward, terminated in a small, acute cornutus.

Female genitalia (Fig. 25): as in the nominate subspecies, the differences are mentioned in the diagnosis.

Remarks: a specimen of this taxon was published by CHANG (1991) as the female of "*P. variegata* WILEMAN".

Panolis exquisita DRAUDT, 1950 (Figs 20, 21, 26, 134, 136)

Type material examined: 2 male, 2 female syntypes, a male is designated here as lectotype: m, "West.Tien-Mu-Shan, (1600m) Pz. Chekiang, 23. 4. 1932. H. Höne." Slide No. MH8998 (coll. MAK, Bonn).

Additional material examined: a long series of specimens from Ost-Tien-mu-shan, Prov. Chekiang, 1931, HÖNE (coll. MAK, HREBLAY).
Slide Nos HM8933 (male), HM8934 (female).

Diagnosis: *P. exquisita* DRAUDT is the continental sister species of *P. variegatoides* POOLE, 1989, representing two distinct, easily separable taxa. The forewing and especially the hindwing of *P. exquisita* are much paler than those of *P. variegatoides*. In the male genitalia, *P. exquisita* has broader valva, cucullus and harpe, wider and stronger thorns on the carina and longer cornuti field in the vesica; in the female genitalia *P. exquisita* has less rounded, more subdeltoidal ostium bursae, shorter ductus bursae and longer signa.

Description of the genitalia. Male (Figs 20, 21): uncus short, proximal half slender, distal half spatulate, triangular, apical edge arcuate. Tegumen low, narrow, fultura inferior elongated, medial crest long, fultura superior strong; vinculum short. Valva elongated, apically tapering, cucullus rounded, setose, corona absent. Sacculus short, clavus reduced. Basal plate of harpe broad, curved, extending over ventral margin, its distal process flattened, broad, short, with apex rounded; ampulla straight, strongly sclerotized. Aedeagus cylindrical, distal part somewhat curved, carina with strong thorns. Vesica tubular, recurved ventrally, distal part with a long cornuti field consisting of small spinules. Medial part with a long, tubular diverticulum, armed with a fine, pointed terminal cornutus.

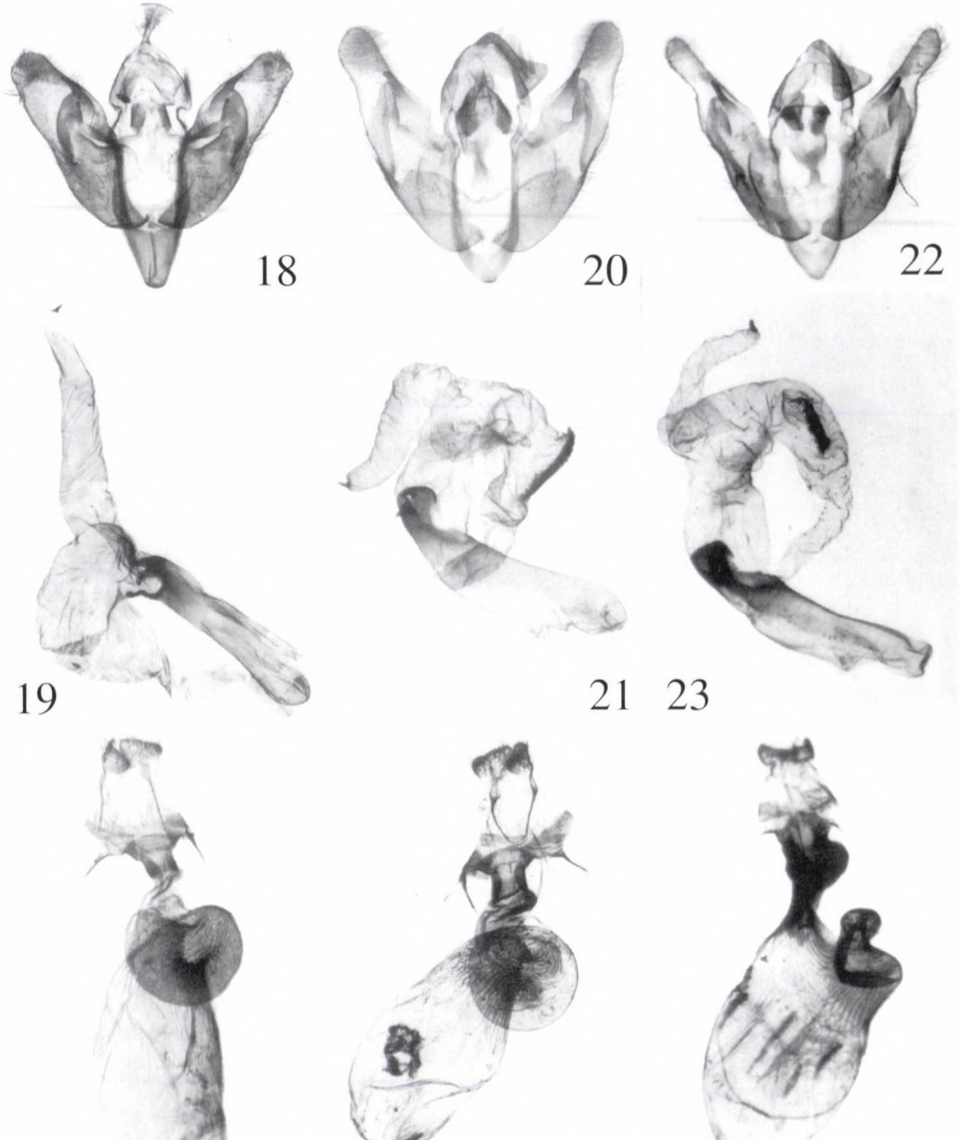
Female (Fig. 26): ovipositor short, weak, gonapophyses fine, short. Ostium bursae subdeltoidal, sclerotized, posterior part of ductus bursae broad, rounded, sclerotized, anterior part tubular, moderately long, with sclerotized ribs. Cervix bursae conical, apically twisted, with sclerotized ribs. Corpus bursae elliptical, apically ribbed, medial third with four signum-stripes.

Panolis variegatoides POOLE, 1989, **stat. rev.** *Hadena variegata* WILEMAN, 1914 (Figs 22, 23, 135)

Type material examined: holotype, "Rantaizan, Formosa, 7500 ft, 11.V.1909, F. Wileman" gen. prep. BMNH Noct. 9713. (coll. BMNH).

Additional material examined: a series of both sexes from the following localities of Taiwan: Prov Miaoli, 49 km E of Tungshih, 2490 m, 23. III. 1996, 121°03'E, 24°19'N, leg. T. CSŐVÁRI & P. STÉGER. Prov. Nantou: 3 km SW of Tsuifeng, 2100 m, 27. III. 1996, 121°10'E, 24°06'N; 1 km W of Tatachia peak, 2520 m, 28. III. 1996, 120°53'E, 23°33'N, leg. T. CSŐVÁRI & P. STÉGER (coll. CSŐVÁRI, HREBLAY); 15 km N of Puli, 500m, 15.III.1996, leg. GY. FÁBIÁN & L. NÉMETH (coll. FÁBIÁN, HERCZIG, L. NÉMETH).
Slide Nos HM7776, HM8717 (males), HM7735 (female).

The taxonomic relationships of *P. exquisita* and *P. variegatoides* are discussed in the diagnosis of the preceding species; the genitalia of the latter taxon are described below.



Figs 18–26. 18–19 = *Panolis pinicortex exornata* ssp. n., paratype; 20–21 = *P. exquisita* DRAUDT, 1950, lectotype; 22–23 = *P. variegatoides* POOLE, 1989; 24 = *P. pinicortex* DRAUDT, 1950, lectotype; 25 = *P. p. exornata* ssp. n., paratype; 26 = *P. exquisita* DRAUDT, 1950

Male genitalia (Figs 22, 23): uncus short, proximal half slender, distal half spatulate, triangular, apical edge almost straight. Tegumen low, narrow, fultura inferior subdeltoidal with stronger apical plate, fultura superior strong; vinculum short. Valva elongated, narrow, apically strongly tapering, cucullus narrow, with apex rounded, setose, corona absent. Sacculus short, clavus reduced. Basal plate of harpe broad, curved, its distal process flattened, rounded triangular; ampulla straight, strongly sclerotized. Aedeagus cylindrical, distal part somewhat curved, carina with strong thorns. Vesica broadly tubular, recurved ventrally, distal part with a long cornuti field consisting of small spinules. Medial part with a long, tubular diverticulum, armed with a fine, pointed terminal cornutus.

Female genitalia: ovipositor short, weak, gonapophyses fine, short. Ostium bursae more or less rounded, sclerotized, posterior part of ductus bursae broadened, rounded, sclerotized, anterior part tubular, long, with sclerotized ribs. Cervix bursae broadly tubular, apically twisted, basal part with stronger, apical half with finer sclerotized ribs. Corpus bursae elliptical, apically ribbed, medial third with four short signum-stripes.

Orthosia (s. l.) conspecta (WILEMAN, 1914) **comb. n.** (Figs 27, 28, 140, 141)

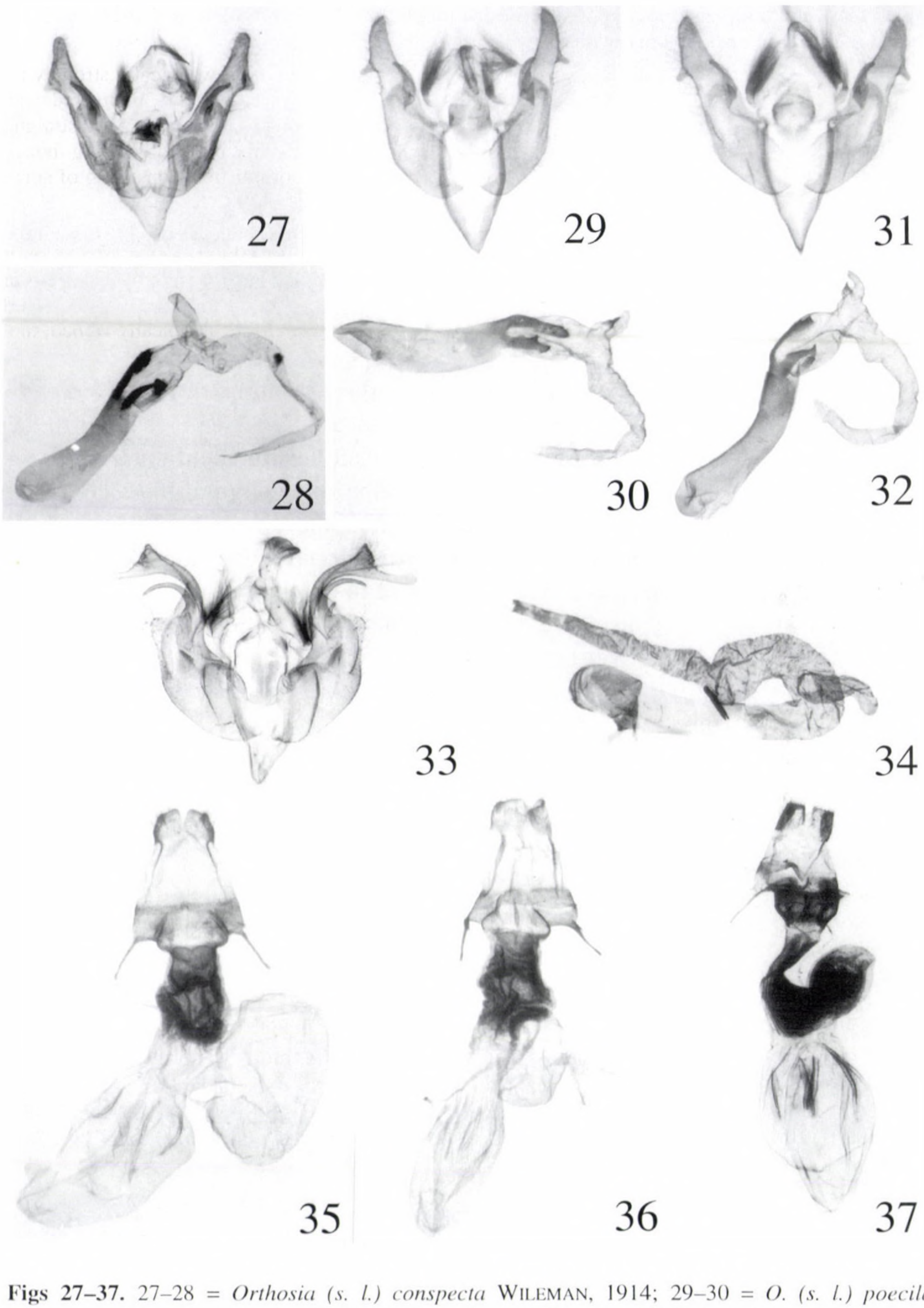
Type material examined: holotype male, Taiwan, Arizan (coll. BMNH).

Additional material examined: Taiwan. Prov. Nantou: 2 m, 3 km SW of Tsuifeng, 2100 m, 7. VIII., 18.VIII.1996, 121°10'E, 24°06'N, leg. T. CSŐVÁRI & L. MIKUS (coll. HREBLAY). Prov. Hualien: 2 m, Hsipao, 980 m, 9–10.X.1996, leg. GY. FÁBIÁN & F. NEMES (coll. FÁBIÁN).
Slide No. HM9347 (male).

Taxonomic notes: the taxa *"Cerapteryx" poecila* DRAUDT, 1950, *"C." conspecta and "C." fumosa* DRAUDT, 1950, can be interpreted, on the basis of several features of the male genitalia (e.g. the structure of the harpe-ampulla complex, the cucullus with pollex etc.) as a distinct lineage within the genus *Orthosia* OCHSENHEIMER, 1816. These species show no closer relationship with the members of the genera *Eriopyga* GUENÉE, 1852, and *Cerapteryx* CURTIS, 1833, as the species were described and used by the subsequent authors. The imagines are on the wing from the late summer to the mid-autumn, this flight period is rather unusual within the genus. The species group is perhaps a distinct supraspecific taxon but, because of the problems of the taxonomy of the tribe Orthosiini, a general revision of the tribe is required for the final decision.

The comparison of the two closely related species, *O. conspecta* and *O. poecila* with its two subspecies, *O. poecila poecila* and *O. poecila fumosa* is given under the diagnosis of the latter species. The species is first illustrated correctly by WANG (1996).

Description of the male genitalia (Figs 27, 28): uncus slender, short, with apex pointed, tegumen low, rather broad, fultura inferior a weakly sclerotized plate, vinculum short, rounded. Valva elongated, slender, apically tapering, cucullus triangular, long, with apex rounded, corona absent; pollex short, weak, cuneate. Sacculus relatively short, rounded, clavus a setose surface. Basal plate of harpe broad, flattened, erected part sclerotized, thorn-like, slightly arcuate. Ampulla short but strong, finely curved, its apex pointed. Aedeagus cylindrical, arcuate, carina with some



Figs 27–37. 27–28 = *Orthosia (s. l.) conspecta* WILEMAN, 1914; 29–30 = *O. (s. l.) poecila* (DRAUDT, 1950), lectotype; 31–32 = *O. (s. l.) p. fumosa* (DRAUDT, 1950), lectotype; 33–34 = *Perigrapha nigrocincta* sp. n., paratype; 35 = *O. (s. l.) poecila* (DRAUDT, 1950), paralectotype; 36 = *O. (s. l.) p. fumosa* (DRAUDT, 1950), paralectotype; 37 = *P. nigrocincta* sp. n., paratype

small teeth and a larger tooth opposedly. Vesica tubular, medial part with a medium-long, membranous diverticulum, distal part with a small cornuti field.

Orthosia (s. l.) poecila (DRAUDT, 1950) **comb. n.**
(Figs 29, 30, 35, 142)

Type material examined: 2 male, 1 female syntypes, one of the males is designated here as lectotype: m, "Li-kiang (China), Provinz Nord-Yuennan 1.7.1935, H. Höne" (MAK, Bonn) Slide No. HM8999. Paralectotypes: 1 m, 1 f, Li-kiang, Nord-Yuennan 4–21.7.1935, HÖNE (MAK, Bonn).

Slide Nos HM4009 (male), HM10001 (female).

Taxonomic notes: the two externally rather strongly different taxa, *O. poecila* and *O. fumosa* have almost identical male genitalia (see Figs 29, 30), differing slightly in the shape of the valva and the cucullus, the configuration of the vesica is the same. The female genitalia show also some slight differences in the shape of the ostium bursae and the lateral lobe of the ductus bursae; the shape and size of the cervix is most probably strongly variable, depending on the mating state of the actual specimen. On the basis of the high conformity of the genitalia, the two taxa are considered as geographic races of the same species, with the priority of *O. poecila* over *O. fumosa*.

Diagnosis: *O. poecila* is the continental sibling species of *O. conspecta* WILEMAN, occurring at the south-eastern border of the Tibetan plateau. The male genitalia of *O. poecila* differ from *O. conspecta* by the broader basis of the ampulla, the longer, narrower pollex, the shape of the teeth of the carina and the size of the cornutus on the diverticulum of the vesica. The genitalia of both sexes of *O. p. poecila* and *O. p. fumosa* are illustrated in Figs 29–32, 35, 36, the males are figured also by DRAUDT (1950).

Orthosia (s. l.) poecila fumosa (DRAUDT, 1950) **stat. n., comb. n.**
(Figs 31, 32, 36, 143)

Type material examined: one male, one female syntypes, the male is designated here as lectotype: "A-tun-tse (Nord Yünnan) Talsohle ca. 3000 m, 19.6.1937. H. Höne" (MAK, Bonn); slide No. HM9000. Paralectotype: female, A-tun-tse (Nord Yünnan) Talsohle ca. 3000 m, 3.7.1937. H. HÖNE, slide No. HM 10002 (MAK, Bonn)

Perigrapha nigrocincta sp. n.
(*Cerapteryx conspecta* WILEMAN, 1914 sensu CHANG 1991)
(*Cerapteryx conspecta* WILEMAN, 1914 sensu WANG 1995: 138)
(Figs 33, 34, 37, 144, 145)

Holotype: 1 m, "Taiwan, Prov. Nantou, Meimu, 2000 m, 28.X.1996, leg. GY. FÁBIÁN & F. NEMES" (coll. FÁBIÁN).

Paratypes: Taiwan. Prov. Nantou: 2 m, with the same data as the holotype; 1 m, 1 km W of Tatachia peak, 2520 m, 13. X. 1995, 120°53'E, 23°33'N; 2 m, 3 km SW of Tsuifeng, 2100 m, 26–27. X. 1995, 121°10'E, 24°06'N, leg. T. CSŐVÁRI & P. STÉGER. Prov. Hualien: 1 f, Kuanyuan, 2380 m, 11–12.X.1996, leg. GY. FÁBIÁN & F. NEMES. Prov. Taitung: 3 m, 5 f, Hsiangyang, Police station, 2320 m, 2.XI.1996; 3 m, 2 km N Liyusan, 1760 m 23.X.1996, leg. GY. FÁBIÁN & F. NEMES (coll. Mus. Univ. Sun-Yat Sen, Kaohsiung, CSŐVÁRI, FÁBIÁN, HREBLAY).
Slide Nos HM7911 (male), HM9742 (female)

Diagnosis: the new species was incorrectly identified as "*Cerapteryx conspecta*" WILEMAN. "*Cerapteryx*" *poecila* and "*C.*" *conspecta* are the members of a small, distinct species-group of *Orthosia* (s. l.), the taxonomic problems of which are discussed above. The male genitalia of *P. nigrocincta* are surprisingly similar to those of the European *Perigrapha i-cinctum* ([DENIS et SCHIFFERMÜLLER], 1775). The characteristic black marking of the forewing – the joint reniform and orbicular stigmata – and the evenly dark hindwing also indicate a closer relationship with the genus *Perigrapha* LEDERER, 1857, than with the large complex of *Orthosia* (s. l.). The autumnal flight period, apparently typical of this species is found also in some Himalayan *Harutaeographa* YOSHIMOTO, 1992, species, which are more closely related to *Perigrapha* (s. l.) than to *Orthosia* (s. l.).

P. nigrocincta sp. n. is unique within the genus *Perigrapha* in having a pale ochreous grey forewing with fused, black orbicular and reniform stigmata and relatively short, less helicoid vesica armed with two terminal cornuti.

Description: wingspan 34–38 mm, length of forewing 16–18 mm. Head and thorax pale ochreous grey or slate-grey, palpi and frons marked with blackish grey, pubescence of thorax rather homogenous. Antennae of male very shortly bipectinate, those of female filiform. Abdomen somewhat darker, more brownish grey, dorsal crest absent. Forewing rather short, high, with apex acute, outer margin evenly arcuate. Ground colour shining, pale ochreous grey of slate-grey, irrorated with a few darker brown and reddish scales, mostly in medial area. Wing pattern reduced, ante- and postmedial crosslines represented by indistinct rows of tiny dark spots, medial line absent, subterminal line marked only by its dark costal patch. Subbasal line short, blackish-brown, costa with some dark brown spots above cell. Orbicular and reniform stigmata very conspicuous, black, fused, forming a horizontal C-mark, resembling the characteristic pattern element of *O. gothica* (LINNAEUS, 1758). Terminal line a row of minute black spots, cilia uniformly ochreous grey. Hindwing shining whitish-ochreous, inner area slightly, marginal field strongly, suffused with dark grey-brown. Transverse line hardly visible, discal spot big, lunulate, dark grey-brown. Terminal line interrupted, dark brown, cilia ochreous with dark medial line. Underside of wings pale whitish grey, forewing suffused, hindwing scarcely irrorated with darker grey-brown. Shadow of orbicular and reniform stigmata, discal spot of hindwing and transverse lines well-discernible, hindwing cell often with a dark streak.

Male genitalia (Figs 33, 34): uncus short, thick, apically tapering, its tip rounded. Tegumen broad, low, penicular lobes small, hairy, vinculum short, Fultura inferior elongated, quadrangular, without crest or process. Valvae symmetrical, elongated, constricted at apical third, forming a narrow, sclerotized neck. Ventral margin rounded at base, with a membranous, setose lobe at medial third. Cucullus small, triangular, with an elongated, apically rounded ventral process ("pollex"), corona weak, short. Sacculus relatively large, clavus a rounded, slightly wrinkled surface. Basal part of harpe flattened, sclerotized, apical process thin, short. Ampulla long, sclerotized, curved, pointed. Aedeagus cylindrical, carina with weakly sclerotized bars, one of them armed with numerous fine, pointed teeth. Vesica tubular, recurved ventrally, medial part with a tubular, membranous diverticulum, distal end two long, fine, spinifom terminal cornuti.

Female genitalia (Fig. 37): ovipositor short, weak, gonapophyses slender, fine. Ostium bursae broad, rather short, more or less trapezoidal, heavily sclerotized. Ductus bursae relatively short, posterior part evenly sclerotized, anterior part dilated, its sclerotized crests running to medial part of cervix bursae. Cervix bursae narrow at base, having a full turning in its axis, terminal part flattened, rounded. Corpus bursae large, membranous, with four long signa.

Meganephria crassa KOBAYASHI et OWADA, 1996 (Figs 42, 43, 149)

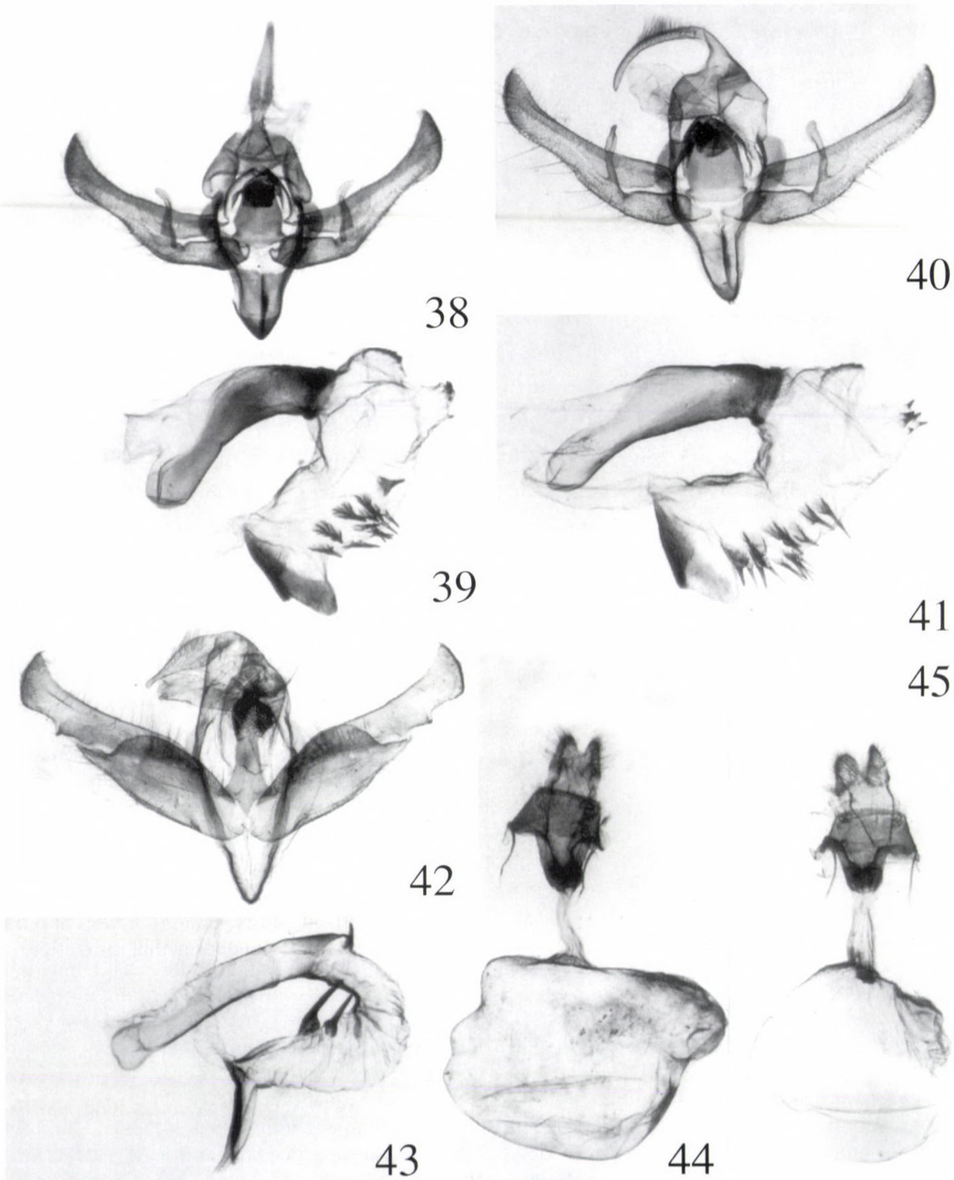
Material examined: Taiwan. Prov. Nantou: 1 m, Meifeng, 17.XII.1990, leg. LIN (coll. Nat. Sci. Museum, Taichung); 4 m, 2 f, 3 km E of Tili, 555 m, 8–9. II. 1997, 120°58'E, 23°47'N, leg. S. SIMONYI & P. STÉGER. Prov. Taoyuan: 2 m, 1 f, 7 km E of Fuhsing, 600 m, 1. II. 1997, 121°23'E, 24°49'N, leg. S. SIMONYI & P. STÉGER (coll. HREBLAY, SIMONYI).

Slide Nos HM9757, RL5757 (males), HM9758 (female).

Taxonomic notes: two species of the *M. extensa* (BUTLER, 1879) species-complex were described recently from Taiwan (KOBAYASHI & OWADA 1996), one of them, *M. crassa*, on the basis of the female sex only. The male genitalia of this species are described and illustrated here, the differences between the genitalia of *M. crassa* and the two other closely related species, *M. extensa* and *M. laxa* KOBAYASHI et OWADA, 1996, are surprisingly large (see Figs 42, 43 and the illustrations of KOBAYASHI & OWADA 1996).

Male genitalia (Figs 42, 43): uncus medium-long, flattened, broadly lanceolate, tegumen narrow, high, penicular lobes reduced. Fultura inferior sclerotized, large, deltoidal, with large, rounded, dentated apical lobe; vinculum strong, V-shaped. Valva long, slender, medial third slightly wider. Cucullus small, more or less triangular, with apex pointed, corona short. Sacculus sclerotized, long, broad, distally rounded, harpe represented by its basal bar, fused with ventral edge of sacculus. Costa broadly sclerotized, costal extension short, triangular, with fine, spine-like apex. Aedeagus long, cylindrical, slightly arcuate, carina with stronger dorso-lateral plate. Vesica broadly tubular, recurved ventrally, basal part with a single, strong spine, medial part scobinate, inner curve with two large, bulbed cornuti, terminal part with a fine, narrow, flattened plate and a long, partly sclerotized, partly scobinate-membranous, bifid appendage ("cornutus").

Figs 38–45. 38–39 = *Meganephria kononenkoi* POOLE, 1989; 40–41 = *M. weixleri* sp. n., holotype; 42–43 = *M. crassa* KOBAYASHI et OWADA, 1996. 44 = *M. kononenkoi* POOLE, 1989; 45 = *M. weixleri* sp. n., paratype



Meganephria weixleri sp. n.
(Figs 40, 41, 45, 148)

Holotype: 1 m, "Taiwan, Prov. Nantou, Meimu, 2000 m, 28.X.1996, leg. GY. FÁBIÁN & F. NEMES", slide No. RL5836 (coll. FÁBIÁN).

Paratypes: Taiwan. Prov. Nantou: 3 m, 3 km SW of Tsuifeng, 2100 m, 17. XI. 1996, 121°10'E, 24°06'N, leg. T. CSŐVÁRI & CS. SZABÓKY. Prov. Taitung: 2 m, 1 f, Hsiangyang, Police station, 2320 m, 25–26. X., 2.XI.1996, leg. GY. FÁBIÁN & F. NEMES (coll. Mus. Univ. Sun-Yat Sen, Kaohsiung, CSŐVÁRI, FÁBIÁN, HREBLAY).
Slide Nos HM9709, HM9711 (males), RL5835 (female).

Diagnosis: the new species is very similar to *M. kononenkoi* POOLE, 1989 (Figs 38, 39, 44), but is generally smaller in size, the wings are narrower, the forewing colouration is more vivid with more distinct crosslines, especially of the subterminal, the stigmata are smaller, the brownish suffusion is stronger and the hindwing is darker. The male genitalia of the new species differ from those of *M. kononenkoi* in the narrower uncus, narrower valva with smaller, lower, less acute cucullus, finer, apically less curved harpe, more quadratic fultura inferior, smaller, less bulbed cornuti and terminal lobe in the vesica; the female genitalia in the shorter ostium bursae with broader but shorter, more sclerotized medial incision, somewhat longer ductus bursae, significantly smaller, discoidal, less quadratic corpus bursae with less prominent, smaller cervix bursae.

Description: wingspan 48–52 mm, length of forewing 22–25 mm. Head and thorax ashy grey, mixed with brownish and some whitish hairs. Palpi, frons, collar and tegulae marked with dark brown and blackish, metathoracic tuft large. Antennae filiform in both sexes, thicker, more inflated in male; abdomen paler grey. Forewing elongated, broad, apex rounded, outer margin slightly crenulate. Ground colour pure or slightly brownish ash-grey, irrorated with dark grey and brown, outer part of medial area often suffused with brownish. Ante- and postmedial crosslines well-marked, double, sinuous, dark grey filled with whitish grey, upper part of medial line narrow, blackish-brown, lower part obsolete. Subterminal rather indistinct, sinuous, whitish-grey, defined by dark arrowheads and irregular, small patches, costal patch and tornal stripe stronger, often blackish. Streak of submedian fold broad, blackish brown. Orbicular and reniform stigmata large, former quadratic, latter broadly elliptical, both encircled with whitish and blackish grey, filled with ground colour; claviform represented by a small blackish arch below orbicular. Terminal line very fine, black, marked with small blackish triangles, cilia whitish with darker inner half. Hindwing glossy, uniformly dark greyish brown, veins slightly darker, discal spot absent. Terminal line dark brown, cilia white, spotted with dark brown. Underside of wings pale greyish white, forewing suffused strongly with darker grey-brown, shadows of discal spots and transverse lines poorly defined.

Male genitalia (Figs 40, 41): uncus long, slender, medially slightly flattened, tegumen low, penicular lobes small, narrow. Fultura inferior sclerotized, flat, quadrangular, finely scobinate, vinculum strong, V-shaped. Valva elongated, distally tapering, cucullus small, pointed, slightly curved; corona long. Sacculus narrow, short, sclerotized, clavus reduced to a minute, setose protuberance. Harpe long, slender, almost straight, apically slightly dilated, having a fine medial crest. Aedeagus short, thick, finely curved, carina covered with minute teeth. Vesica broad, tubular, recurved ventrally, with two conical subbasal diverticula, one of them armed with a small dentated plate, second one with a group of small, conical, bulbed cornuti. Terminal part armed with a sclerotized, flattened terminal plate and a large, partly strongly sclerotized, trapezoidal terminal lobe

("cornutus"). Medial third bearing two groups of bulbed cornuti at two sides of outer curve, those of right side being considerably larger, thicker.

Female genitalia (Fig. 45): ovipositor short, broad, gonapophyses short, slender. Ostium bursae calyculate, ventral plate with wide, deep medial incision, having sclerotized margins. Ductus bursae tubular, membranous, wrinkled, with fine sclerotization at junction to corpus bursae. Cervix bursae semiglobular, rugose, scobinate, its posterior edge granulosely sclerotized. Corpus bursae spacious, rounded-discoidal, membranous with very fine scobination.

Allophyes albithorax (DRAUDT, 1950) (Figs 46, 47, 150)

Type material examined: two male syntypes, one of them is designated here as lectotype: male, "Hoengshan, Prov. Hunan, 15. 11. 1933. Höne" (coll. MAK, Bonn) Slide No. BOURSIN Hö. 124. Paralectotype: 1 male, Hoengshan, Prov. Hunan, 21.11.1933, H. HÖNE (coll. MAK, Bonn).
Slide No. HM8992 (male)

Taxonomic notes: the eastern Palaearctic species of the genus belong to two, rather remote species groups. *A. heliocausta* BOURSIN, 1957 (Figs 48, 49, 151), is a member of the "typical" line of *Allophyes* TAMS, 1942, the species of which are distributed widely in the western Palaearctic region; *A. heliocausta* is a close relative of *A. benedictina* (STAUDINGER, 1891), *A. asiatica* (STAUDINGER, 1891) and *A. metaxys* BOURSIN, 1953. The second species group, containing *A. albithorax* and two new species, *A. miaoli* sp. n. and *A. yuennana* sp. n., represent the most ancient lineage within the genus. This species group is characterized by the less developed uncus, high, quadrangular fultura inferior, almost symmetric (*A. albithorax*) or more or less symmetric valvae (*A. yuennana*), displaying the asymmetry in the cucullus and the costal extension, well developed clavus, reduced harpe, tubular, slender aedeagus with rather simple carina and the more or less globular or broadly tubular vesica with not (*A. albithorax*) or less differentiated (*A. yuennana*) cornuti.

The male genitalia of *A. albithorax* are illustrated by BOURSIN (1953, 1957), with uneverted vesica penis. The detailed description of the male genitalia is given below, the comparison with those of *A. yuennana* can be found under the diagnosis of the new species.

Male genitalia (Figs 46, 47): uncus short, bifurcate, with narrow, apically converging, densely setose arms, tegumen small, low, narrow, penicular lobes also narrow, long, sclerite long, slender. Fultura inferior sclerotized, high, quadrangular with rounded triangular ventral part; vinculum short but strong, V-shaped. Valvae rather short, almost symmetric, apically slightly tapering, cucullus with strong, wedge-shaped costal lobe and apical process. Sacculus short, clavus well developed, lobate, granulosely sclerotized, densely setose. Harpes symmetric, reduced to their flattened, rhomboidal basal plates, costal extensions rather short, thick, acute, somewhat broader, stronger on left valva. Aedeagus slender, tubular, arcuate, carina with granulosely sclerotized dorsal and ventral plates. Vesica short, basal part globular, dorsal surface armed with numerous strong but short, acute spines, ventro-lateral surface with fine scobination, ventral edge with a small, sclerot-

ized crest, ventral edge with a tiny, pointed spinule close to carina. Distal part tubular, membranous.

Allophyes yuennana sp. n.
(Figs 50, 51, 152)

Holotype: male, "Likiang, (China), Provinz Nord-Yuennan, 27. 10. 1934. H. Höne", Slide No. HM8993 (coll. MAK, Bonn)

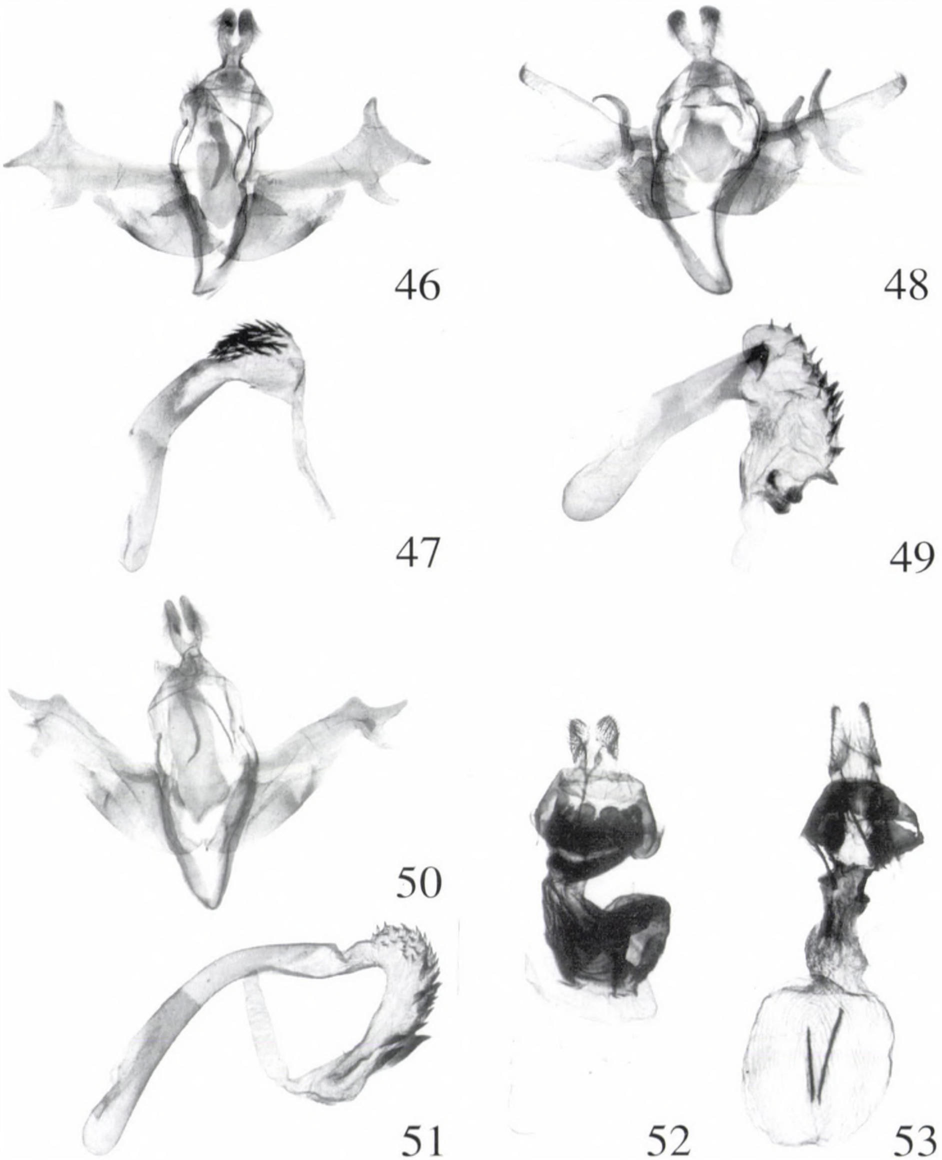
Diagnosis: the new species is a close relative of *A. albithorax* and *A. miaoli* sp. n. It differs from the Chinese sibling species by its somewhat more greyish thorax, broader, more rounded forewings with darker colouration, less sharply defined white(ish) forewing markings, shorter, smaller reniform stigma, simple, blackish ante- and postmedial crosslines and less darkened subcellular zone of the forewing. The male genitalia show rather strong differences, the whole apparatus is considerably larger in *A. yuennana*, the uncus is longer, the fultura is larger, with more pointed lower extremity, the valvae are more asymmetric, longer, with smaller, rounded costal lobe but with additional processi on costal extension, the aedeagus and the vesica are much longer, the latter is armed with considerably larger cornuti at distal half, etc.

The external appearance of the second related species, *A. miaoli* is even closer, but *A. yuennana* has more whitish collar and thorax, more red-brownish ground colour of forewing with less intense metallic green irroration, narrower, sharper white definition below the claviform stigma and the lower part of the postmedial line, etc. The genitalia cannot be compared, owing to the lack of specimens the same sex of the two species.

Description: wingspan 43 mm, length of forewing 22 mm. Head dark fuscous brown, lateral sides of palpi blackish, vertex with a big, pointed tuft, antennae of male thick, bipectinate. Collar and tegulae whitish; collar with a few blackish scales at base. Forewing rather broad with apex finely pointed, scaling finely reticulate. Ground colour dark greyish brown with fine red-brownish suffusion, upper half of marginal area covered with whitish grey. Metallic green irroration reduced to a few scales inside reniform stigma and along anal veins. Antemedial and postmedial lines simple, sharply defined, blackish brown, less sinuous, latter marked with a fine whitish streak at inner margin; streak of submedian fold long, rather broad, black. Orbicular and reniform stigmata large, rounded, encircled with blackish, filled with ochreous grey; claviform long, acute, its outline fine, black, defined by a whitish arch below. Subterminal diffuse, whitish, with a dark brown costal patch and a few blackish arrowheads at apex and near tornus; tornal streak long, blackish, outer margin with two fine, black streaks above tornus. Terminal line a row of fine brown arches, cilia whitish, spotted with grey-brown. Hindwing ochreous, suffused with darker brown, marginal area and veins somewhat darker, transverse line a pale, diffuse shadow; cilia brownish. Underside of wings whitish, forewing strongly suffused, hindwing scarcely irrorated with greyish brown, discal spot of hindwing relatively strong, big, transverse lines of both wings diffuse.

Male genitalia (Figs 50, 51): uncus relatively long, bifurcate, with narrow, apically converging, densely setose arms, tegumen small, low, narrow, penicular lobes also narrow, long, sclerite long, slender. Fultura inferior sclerotized, very high, more or less quadrangular with triangular ven-

tral part; vinculum strong, V-shaped. Valvae elongated, apically tapering, cucullus with a small, rounded costal lobe and long, wedge-shaped apical process. Sacculus short, clavus a rounded, finely crenulate, densely setose lobe. Harpes symmetric, reduced to their flattened, long, rhomboidal basal plates. Costal extensions asymmetric, bearing an additional, medial process. Left extension stronger, longer, its additional process long, straight, right extension significantly shorter, its addi-



Figs 46–53. 46–47 = *Allophyes albithorax* (DRAUDT, 1950), paralectotype; 48–49 = *A. heliocausta* BOURSIN, 1957, paratype; 50–51 = *A. yuennana* sp. n., holotype; 52 = *A. miaoli* HREBLAY et KOBAYASHI, sp. n., holotype; 53 = *Dryobotodes formosanus* HREBLAY & RONKAY, 1997

tional process small, rounded. Aedeagus long, slender, tubular, arcuate, carina with granulosely sclerotized, shorter dorsal and much longer ventral plate. Vesica broadly tubular, recurved ventrally, dorsal surface armed with numerous strong, acute, wide-based cornuti, their size increasing from base to distal part of vesica. Ventral surface finely scobinate, terminal third with a narrow zone of minute spiculi and a rather weakly sclerotized terminal crest.

Allophyes miaoli HREBLAY et KOBAYASHI, sp. n. (Figs 52, 153)

Holotype: female, "TAIWAN, Prov Miaoli, 49 km E of Tungshih, 2490 m, 11. XI. 1996, 121°03'E, 24°19'N, leg. T. Csővári & Cs. Szabóky", slide No. HM9392 (coll. HREBLAY).

Paratypes: Taiwan. Prov. Ilan: 2 f, 23.XI.1995, leg. H. KOBAYASHI (coll. KOBAYASHI, Tokyo).

Diagnosis: the new species is a sibling of *A. yuennana* sp. n.; a comparison of the three related species of the *A. albithorax* group is given under *A. yuennana*.

Description: wingspan 41 mm, length of forewing 21 mm. Head dark fuscous brown, lateral sides of palpi blackish, vertex with a big, pointed tuft, antennae of female filiform. Thorax wide, tegulae large, consisting of big, scale-like, grey and whitish hairs; collar with strong, black basal streak. Abdomen ochreous grey mixed with brownish, dorsal crest reduced to a small tuft of 2nd segment. Forewing rather broad with apex finely pointed, scaling finely reticulate. Ground colour dark greyish brown, marginal area suffused with whitish grey, costal area, a wide zone along inner margin and reniform stigma irrorated with brilliant metallic green scales. Antemedial and postmedial lines simple, blackish brown, less sinuous, latter defined by a whitish streak and a dark brown patch at inner margin; streak of submedian fold long, broad, black. Orbicular and reniform stigmata large, rounded, encircled partly with blackish, filled with ochreous grey; claviform more obsolescent, its outline incomplete, defined by a whitish patch below it. Subterminal diffuse, whitish, with a dark brown costal patch and a few blackish arrowheads at apex, tornal streak long, blackish, outer margin with two fine, black streaks above tornus. Terminal line a row of fine brown arches, cilia whitish, spotted with grey-brown. Hindwing suffused with dark greyish brown, marginal area and veins somewhat darker, transverse line a pale, diffuse shadow; cilia whitish with brown line. Underside of wings whitish, suffused strongly with greyish brown, discal spot of hindwing relatively strong, big, transverse lines of both wings diffuse.

Female genitalia (Fig. 52): ovipositor short, relatively strong, gonapophyses short, fine. Ostium bursae large, caudal part more or less quadrangular, granulosely sclerotized, dorsal plate with an arcuate, sclerotized ribbon, ventral plate with a rounded caudal lobe; anterior part broad but short, asymmetric, cup-shaped with strong scobination. Ductus bursae medium-long, broad, proximally dilated and curved, both surfaces partly scobinate, partly strongly sclerotized, rugose. Cervix bursae big, rounded, discoidal, slightly folded, smoothly sclerotized, corpus bursae elliptical-sacculiform, membranous, without signa.

Lithophane trimorpha sp. n. (Figs 58–60, 158–160)

Holotype: male, "TAIWAN, Prov. Nantou, 5 km SW of Tayüling, 2900 m, 7–8. XI. 1996, 121°17'E, 24°09'N, leg. T. Csővári & Cs. Szabóky", slide No. HM9368 (coll. HREBLAY).

Paratypes: Taiwan. Prov. Nantou: 3 m, 1 f, with the same data as the holotype. Prov. Miaoli: 2 m, 2 f, 49 km E of Tungshih, 2490 m, 28.X., 11.XI. 1996, 121°03'E, 24°19'N, leg. T. CSŐVÁRI & CS. SZABÓKY, (coll. CSŐVÁRI, HREBLAY, SZABÓKY). Prov. Taitung: 2 m, 1 f, Hsiangyang, Police station, 2320 m, 2.XI.1996, leg. GY. FÁBIÁN & F. NEMES (coll. FÁBIÁN). Prov. Taichung: 1 female, Anmashan, 2100 m, 12.I.1992. leg. H. KOBAYASHI (coll. KOBAYASHI).

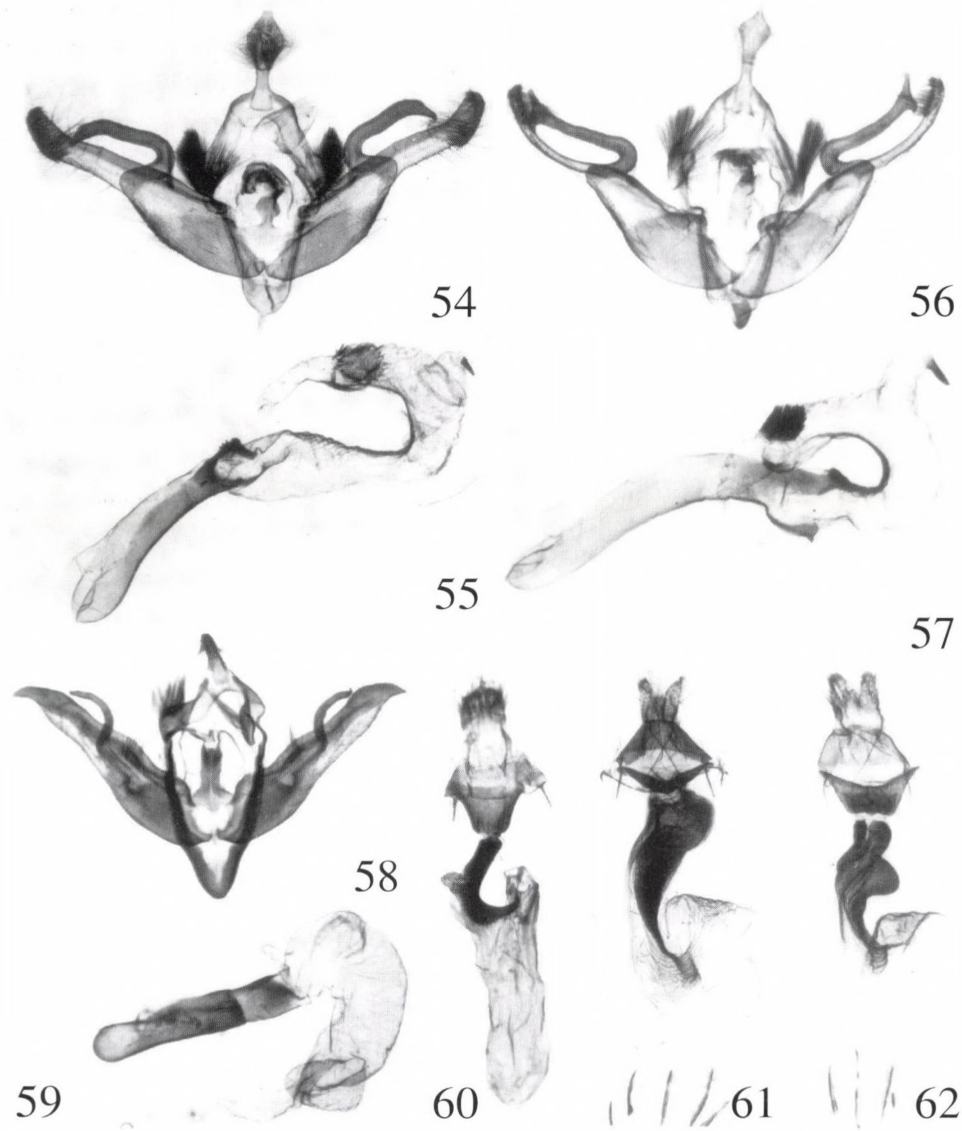
Slide Nos HM9356, HM9357, HM9358, HM9369, HM9382, RL5830, RL5831 (males), HM9375, HM9383 (females).

Diagnosis: the new species has three colour forms, two of them resemble unicolorous specimens of *L. consocia* (BORKHAUSEN, 1792) and *L. furcifera* (HUFNAGEL, 1767), but the forewings are more glossy, the dark pattern is more reduced, less sharply defined and the scaling is strongly reticulate. The third form, with its rather strong red-brownish irroration of the forewing is unique within the Old World species of the genus. The male genitalia of *L. trimorpha* are rather simple, differing from all related taxa (e.g. *L. consocia*, *L. furcifera*, *L. lamda* (FABRICIUS, 1775), etc.) by the complete lack of the corona and the separated costal extension (the cucullus itself is a part of the heavily sclerotized costa), the vesica is membranous, tubular, having three diverticula but without any cornuti. The female genitalia of the new species are most similar to those of *L. furcifera*, but the ostium bursae is somewhat longer, the ductus bursae is longer, more tubular, much stronger in sclerotization, having a membranous lateral emergence. The female genitalia of *L. lamda* have longer, narrower ostium bursae with a large, rounded caudal lobe, the ductus is significantly weaker in sclerotization, the lateral emergence is missing.

Description: wingspan 41 mm, length of forewing 20 mm. Head and thorax more or less unicolorous, variably dark grey mixed with a few brownish, frons and palpi with blackish grey markings. Antennae filiform in both sexes, pro- and metathoracic tufts large; abdomen paler greyish. Forewing elongated, rather high, with apex pointed, outer margin finely crenulate. Ground colour glossy, variably dark ashy or plumbeous grey, scaling strongly reticulate. Unicolorous forms having reduced wing pattern, ante- and postmedial crosslines fine, obsolescent, sinuous, darker grey, filled with a few whitish-grey, subterminal very pale, whitish, marked with a pale reddish-brownish shadow and some dark spots. Orbicular stigma deleted, reniform large, incompletely encircled by blackish and whitish grey, filled with pinkish grey. Claviform large, partly or entirely outlined by black. Marked form has sharply defined, double, sinuous subbasal, ante- and postmedial crosslines, well-defined stigmata. Medial area strongly irrorated with reddish, inner shadow of subterminal line broadly red-brownish. Hindwing glossy, uniformly dark cupreous brown, inner part of wing sometimes slightly lighter. Underside of wings brownish grey with some reddish tinge, transverse line and discal spot diffuse but present on both wings.

Male genitalia (Figs 58, 59): uncus short, flattened, cuneate with finely dilated apex. Tegumen low, penicular lobes sclerotized, rounded. Fultura inferior subdeltoidal with small, triangular basal and high, flattened apical plate, lateral margins with stronger sclerotization; vinculum strong, rather short, V-shaped. Valva long, narrow, apically tapering, cucullus small, falcate-triangular, corona absent. Sacculus short, rounded, clavus reduced, harpe long, slender, more or less S-shaped, apex acute. Aedeagus relatively short, slender, cylindrical, carina with short, bill-like ventral plate. Vesica broadly tubular, membranous, everted forward, slightly upturned at base, then curved ventrally. Basal part with a small basal and a larger, rounded subbasal diverticula, distal third with a conical terminal diverticulum.

Female genitalia (Fig. 60): ovipositor relatively short, weak, gonapophyses short, fine. Ostium bursae large, trapezoidal, smoothly sclerotized, with stronger lateral margins. Ductus bursae medium-long, proximally strongly curved, both surfaces partly heavily sclerotized, partly membranous, medial part with a small, wrinkled, membranous lateral emergence. Cervix bursae small, subconical, wrinkled, corpus bursae elliptical-sacculiform, membranous, without signa.



Figs 54–62. 54–55 = *Antivaleria viridimacula* (GRAESER, 1888); 56–57 = *A. viridentata* sp. n., holotype; 58–60 = *Lithophane trimorpha* sp. n.: 58–59 = holotype, 60 = paratype; 61 = *A. viridimacula* (GRAESER, 1888); 62 = *A. viridentata* sp. n., paratype

Dryobotodes formosanus HREBLAY et RONKAY, 1997
(Figs 53, 147)

Additional material examined: Taiwan. Prov. Nantou: 2 f, Tayuling, 2550 m, 7–8. 10. 1996, leg. GY. FÁBIÁN & F. NEMES (coll. FÁBIÁN). Prov Miaoli: 2 f, 49 km E of Tungshih, 2490 m, 11. XI. 1996, 121°03'E, 24°19'N, leg. T. CSŐVÁRI & CS. SZABÓKY (coll. HREBLAY).

Slide No. HM9393 (female).

Taxonomic notes. The species was recently described, together with its Nepalese sibling, *D. cerriformis* HREBLAY et RONKAY, 1997 (in print). The unique holotype of *D. formosanus* is a male, the female was unknown at the time of description. The subsequent expeditions to Taiwan successfully collected further material of this species, including females. The sexes are similar externally, the female genitalia are described here (Fig. 53): distal part of ovipositor weak, hardly sclerotized and longer proximal part stronger and wider. Gonapophyses of the distal segment one and a half longer than of those of the proximal one. Ostium short, simple, dorsally somewhat turned up. Ductus bursae straight, hardly and granulosely sclerotized, with an inflated part proximally. Cervix bursae minute, corpus bursae rounded with two long signa.

Antivaleria viridentata sp. n.
(Figs 56, 57, 62, 154, 155)

Holotype: male, "Taiwan, Prov. Taitung, Hsiangyang, 2320 m, 2.XI.1996, leg. GY. FÁBIÁN & F. NEMES", slide No. RL5839 (coll. FÁBIÁN).

Paratypes: Taiwan. Prov. Taitung: 1 f, with the same data as the holotype; 1 m, from the same locality, 25–26.X.1996, leg. GY. FÁBIÁN & F. NEMES. Prov. Ilan: 2 m, 9 f, Szuyuan-Yakou, 1800 m, 23. XI. 1995, leg. H. KOBAYASHI and M. OWADA (coll. National Science Museum, Tokyo and KOBAYASHI).

Slide No. RL5861 (female).

Diagnosis: the new species is closely related to *A. viridimacula* (GRAESER, 1888) (Figs 54, 55, 61). *A. viridentata* differs from its sibling species in the more vivid greenish colouration, more sharply defined stigmata, less sinuous ante- and postmedial crosslines, stronger teeth of the subterminal line and the darker, more unicolorous hindwing. The male genitalia of the new species have narrower uncus with longer apical process, narrower but much higher fultura inferior, larger clavus, narrower distal half of valva and cucullus, significantly longer harpe having dilated, double-peaked apex, longer aedeagus with stronger sclerotized extensions of carina, shorter curve of vesica with large medial diverticulum and cornutus and stronger subterminal spinulose field consisting of stronger spinules. In the female genitalia *A. viridentata* has longer, broader ostium bursae,

shorter ductus bursae with smaller postero-lateral lobe, smaller cervix with smaller but more strongly sclerotized plate.

Description: wingspan 40–43 mm, length of forewing 19–21 mm. Head and thorax dark reddish brown mixed with mossy green, palpi and edges of tegulae marked with dark brown. Antennae of male finely bipectinate, those of female filiform. Pro- and metathoracic tufts large, greenish, abdomen dark brownish-grey, dorsal crest strong. Forewing broadly triangular with apex pointed, outer margin crenulate. Ground colour glossy, dark brown, suffused with vivid mossy green, variegated with blackish grey. Wing pattern sharply defined, costal margin striolate with blackish-grey and greenish, inner margin narrowly reddish. Subbasal, ante- and postmedial crosslines sharply defined, slightly sinuous, blackish, defined by silvery-white. Subbasal and antemedial more or less arcuate, postmedial straight below cell interrupted by a double-peaked, grey patch at lower extremity of reniform. Subterminal silvery-white, defined by blackish grey at outer side, strongly dentated, inner half of marginal area entirely moss-green. Orbicular and reniform stigmata large, former rounded, latter more or less quadratic, encircled with whitish green, filled with darker green and some blackish grey, claviform a big, blackish-grey patch. Terminal line a row of fine blackish arches, cilia pinkish-brown. Hindwing shining, dark cupreous brown, discal spot and transverse line diffuse but well-discernible. Terminal line brown, cilia ochreous brown with darker medial line. Underside of wings pale greyish white, irrorated with darker grey, costal parts suffused with reddish brown, inner area of forewing darker grey. Discal spots and transverse lines present, dark brownish grey.

Male genitalia (Figs 56, 57): uncus short, flattened, distal part lanceolate. Tegumen moderately high, penicular lobes densely setose with long, fine setae. Fultura inferior sclerotized, high subdeltoidal with apical part laterally wrinkled, apically pointed; vinculum short, strong. Valva elongated, basal half broader, distal half narrow, arcuate, cucullus small, narrow, with apex pointed, corona long. Sacculus short, clavus a big, setose, finely rugulose lobe. Harpe very strong, long, slightly S-shaped, curved at base, finely arcuate distally, apical part dilated, Y-shaped with pointed apices. Aedeagus long, cylindrical, arcuate, carina with two long, ribbon-like extensions, dorsal bar longer, dentated, ventral bar shorter, stronger, terminated in a single, peaked tooth. Vesica tubular, recurved dorsally, then bent ventrally; its walls finely scobinate. Medial part with a long, subconical diverticulum armed with a wedge-shaped cornutus, distal part with a bigla subterminal spinulose field consisting of fine spinules and a strongly scobinate diverticulum on inner curve.

Female genitalia (Fig. 62): ovipositor relatively short, weak, gonapophyses short, fine. Ostium bursae large, trapezoidal, ventral plate with smoothly sclerotized posterior third, wrinkled medial part and granulose anterior third, dorsal plate much smaller, scobinate. Ductus bursae long, connected with ostium with a short, membranous neck. Distal half flattened, granulosely sclerotized, posterior edge with two stronger, rounded ventral plates, posterior third with a big, rounded, lateral lobe on left side, continued in a long, granulose ribbon terminated at base of cervix. Proximal half membranous, rugulose, with finely sclerotized wrinkles. Cervix bursae large, more or less rounded, apical part sclerotized, wrinkled. Corpus bursae elliptical, membranous, with three long and a much shorter signum-stripes.

Polymixis viridinigra sp. n.
(Figs 63, 64, 71, 156, 157)

Holotype: male, "TAIWAN, Prov. Nantou, 7 km SW of Tayüling, 3000 m, 19.VIII.1996, 121°16'E, 24°08'N, leg. T. Csővári & L. Mikus", slide No. HM9308 (coll. HREBLAY).

Paratypes: Taiwan. Prov. Nantou: 5 f, with the same data as the holotype; 1 f, 5 km SW of Tayuling, 2900 m, 6.VIII.1996, 121°17'E, 24°09'N, leg. T. CSŐVÁRI & L. MIKUS, 1 m, 5 f, from

the same locality, 8.X.,19.X.1995, 121°17'E, 24°09'N; 1 f, 1 km W of Tatachia peak, 2520 m, 22.X.1995, 120°53'E, 23°33'N, leg. T. CSŐVÁRI & P. STÉGER; 3 m, 2 f, Tayuling, 2550 m, 7–8. X, 11–12.X.1996, leg. GY. FÁBIÁN & F. NEMES. Prov. Taitung: 1 f, 2 km N of Tupan, 500 m, 24.X.1995, 120°52'E, 22°29'N, leg. T. CSŐVÁRI & P. STÉGER; 2 f, Hsiangyang, Police station, 2320 m, 25–26.X.1996, leg. GY. FÁBIÁN & F. NEMES. Prov. Hualien: 1 m, 6 f, Kuanyuan, 2380 m, 11–12.X.1996, leg. GY. FÁBIÁN & F. NEMES (colls CSŐVÁRI, FÁBIÁN, HREBLAY).

Slide No. HM9743 (female).

Diagnosis: the new species resembles externally to some Central and Inner Asian *Atrachea* (s. l.) species (e.g. *A. viridula* (STAUDINGER, 1895), comb. n., *A. munda* (LEECH, 1900), comb. n.), but the genital structures clearly show its close relationship with *Polymixis* HÜBNER, [1820] 1816 (s. l.), representing a distinct species-group within the complex, related mostly the typical group (subgenus *Polymixis*). The main types of the male genitalia of *Polymixis* are illustrated by HACKER & RONKAY (1993). The most characteristic specific features of *P. viridinigra* in the male genitalia are the evenly rounded cucullus and the huge subbasal cornutus of the vesica, in the female genitalia the strong, acute ovipositor.

Description: wingspan 37–42 mm, length of forewing 17–20 mm. Head and thorax blackish, mixed with whitish, green and grey scales. Antenna filiform in both sexes, basal tuft large, white. Abdomen grey, dorsal crest present, strong. Forewing triangular with apex rounded, ground colour shining, dark olive-green, irrorated with black and white. Wing pattern sharply defined, veins covered with grey. Subbasal line double, black, filled with white, antemedial and postmedial lines double, sinuous, inner lines white, outers blackish; medial line indistinct, blackish. Orbicular and reniform olive-green, encircled with white, claviform a blackish shadow. Subterminal whitish, with some arrowhead-like markings, terminal line a row of black spots between veins, cilia white, spotted with dark brown. Hindwing glossy, almost unicolorous dark brown, discal spot absent, terminal line ochreous, cilia whitish with dark basal line. Underside of forewing patternless, blackish, cilia chequered, hindwing suffused with dark brown, transverse line indistinct, cilia whitish.

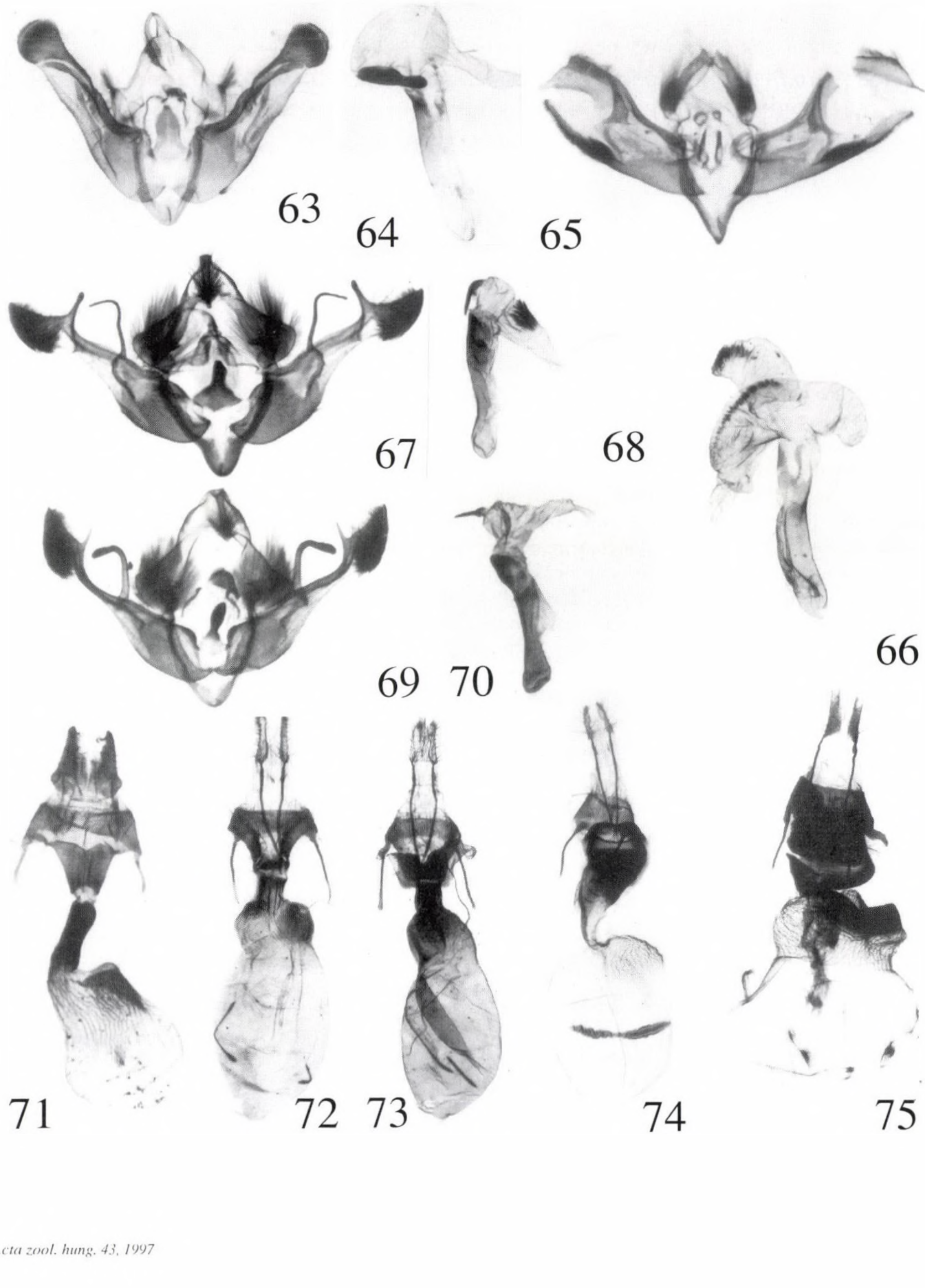
Male genitalia (Figs 63, 64): uncus long, slender, pointed, tegumen broad, penicular lobes relatively big, quadrangular. Fultura inferior subdeltoidal with high, broad, flattened apical plate, vinculum strong, short, V-shaped. Valva elongated, narrow, apically slightly dilated. Cucullus small, rounded, sclerotized, corona rather weak. Sacculus short, clavus a setose, rounded lobe, harpe reduced to its long, slender basal bar, ampulla small, weak, digitiform. Costa sclerotized, costal extension short, narrow, slightly arcuate with apex finely rounded. Aedeagus relatively short, slender, cylindrical, ventral plate of carina with short, sclerotized extension. Vesica semiglobular, membranous, distally upturned, armed with a strong, big, duck-head-like subbasal cornutus.

Female genitalia (Fig. 71): ovipositor relatively short, strong, posterior papillae sclerotized, conical, acute, gonapophyses short, thick. Ostium bursae large, sclerotized, trapezoidal with arcuate anterior edge. Ductus bursae medium-long, tubular, dorsal surface wrinkled, ventral surface and lateral margins sclerotized. Apical half of bursa with finely sclerotized wrinkles, cervix bursae double-peaked, wrinkled, corpus bursae elliptical, proximal half membranous, without signa.

Blepharosis theobroma sp. n.
(Figs 65, 66, 164)

Holotype: male, "TAIWAN, Prov. Nantou, 3 km SW of Tsuifeng, 2100 m, 9. XI. 1996, 121°10'E, 24°06'N, leg. T. Csővári & Cs. Szabóky", slide No. HM9389 (coll. HREBLAY).

Figs 63–75. 63–64 = *Polymixis viridinigra* sp. n., holotype; 65–66 = *Blepharosis theobroma* sp. n., holotype; 67–68 = *Xanthia tatachana* CHANG, 1991; 69–70 = *X. aculeata* HREBLAY et RONKAY, 1997; 71 = *P. viridinigra* sp. n., paratype; 72 = *X. tatachana* CHANG, 1991; 73 = *X. aculeata* HREBLAY et RONKAY, 1997; 74 = *Telorta shenhornyeni* sp. n., paratype; 75 = *T. atrifusa* sp. n., holotype



Diagnosis: the taxonomic placement of the species is rather tentative. The new species differs externally from all known members of the genus in its uniformly dark, chocolate-brown ground colour with less distinct, dark greyish ante- and postmedial crosslines; the reniform stigma, consisting of smaller and bigger white(ish) spots and arch is also unusual in *Blepharosis* BOURSIN, 1964. The male genital capsula resembles in type to those of the *B. lama* (PÜNGELER, 1901)-species group in the separated costal and saccular parts of the valva, strong, acute, claw-like clavus, etc., but the costal and saccular parts are more elongated, the latter bearing a long setose field. The aedeagus differs from the other species of the genus by the lack of the ventral spine of the carina and the strong cornuti of the vesica, armed with two spinulose fields consisting of fine spiculi.

Description: wingspan 26 mm, length of forewing 13 mm. Head and thorax dark chocolate-brown mixed with a few greyish hairs only, tips of thoracic crest slightly greyish. Abdomen only slightly paler brown, dorsal crest represented by a blackish tuft on 2nd segment. Forewing short, high triangular, with apex pointed, outer margin finely crenulate. Ground colour glossy, dark chocolate-brown, basal and marginal areas with some plumbeous grey suffusion. Crosslines less distinct, antemedial line oblique, less sinuous, medial line a diffuse, narrow stripe, postmedial strongly sinuous, almost straight below cell. Orbicular stigma small, incompletely encircled with whitish spots, reniform large, narrow, marked with minute whitish dots, a fine ochreous inner arch and a big, rounded white spot. Subterminal obsolescent, interrupted, ochreous-brownish, terminal line fine, ochreous, defined with dark brown; cilia as ground colour. Hindwing uniformly dark brown, somewhat darker than forewing, discal spot big, rounded, shadow-like. Terminal line ochreous, cilia dark brown. Underside of wings ochreous, covered strongly with dark greyish brown, transverse lines and discal spots present, latter strong, dark on hindwing, paler, defined by an ochreous spot on forewing.

Male genitalia (Figs 65, 66): tegumen low, narrow, penicular lobes elongated, narrow, densely hairy. Fultura inferior V-shaped with fine, acute base and folded, dilated lateral arms; vinculum strong, V-shaped. Valva elongated, distal half dilated, cucullus small, triangular, sclerotized, with finely pointed apex and long, acute ventro-lateral extension; corona reduced. Sacculus long, rather narrow, with a long, sclerotized projection fused with ventral margin, its basal half strongly setose. Clavus long, flattened, falcate, harpe long, strong, cuneate, slightly arcuate. Aedeagus relatively short, cylindrical, carina with eversible, flattened bars. Vesica broadly tubular, characteristically christ-shaped. Main tube recurved dorsally, finely scobinate, armed with a small sclerotized plate and a long, narrow spinulose field. Basal part of vesica with two big, elongated diverticula, one of them projected ventrally, second directed forward, terminated in a relatively large spinulose field consisting of fine spiculi.

Himalistra soluta sp. n.
(Figs 82, 166)

Holotype: female, "TAIWAN, Prov. Nantou, 5 km SW of Tayüling, 2900 m, 7–8. XI. 1996, 121°17'E, 24°09'N, leg. T. Csővári & Cs. Szabóky", slide No. HM9377 (coll. HREBLAY).

Diagnosis: the Taiwanese species of the closely related genera *Himalistra* HACKER et RONKAY, 1993, and *Estagrotis* NYE, 1975, represent distinct phyletic lines within the genera, according to their genital features. *Himalistra soluta* sp. n. has a strongly, more or less evenly sclerotized, folded ductus bursae, while it is weaker, rugulose, granulosely sclerotized or covered by fine spiculi in the other *Himalistra* species. The new species resembles externally to the dark brownish form of *H. obscura* HREBLAY et PLANTE, 1995, differing from it by the partly ochreous outlines of the orbicular and reniform stigmata.

Description: wingspan 35 mm, length of forewing 16 mm. Head and collar pale greyish brown, tegulae and thorax dark chocolate brown; abdomen somewhat paler brown. Antennae of female filiform. Forewing elongated, apex finely pointed, ground colour dark brown. Antemedial line double, blackish, waved, filled with ochreous-brownish, postmedial line more diffuse, slightly sinuous, its filling also paler than ground colour. Orbicular and reniform stigmata rather sharply defined, encircled with blackish-brown and ochreous, filled with ochreous-brownish. Subterminal indistinct, ochreous, sinuous, defined by a darker brown shadow and a few diffuse arrowhead-like markings at inner side; outer half of marginal area somewhat lighter, cilia ochreous. Hindwing evenly dark fuscous, veins somewhat darker, cilia ochreous. Underside of both wings brownish grey, transverse lines and discal spots present, diffuse. Male unknown.

Female genitalia (Fig. 82): ovipositor conical, acute, posterior papillae anales relatively strong, gonapophyses slender, rather long. Ostium bursae heavily sclerotized, broad, short, more or less quadratic, with slight caudal incision. Ductus bursae long, posterior part heavily sclerotized, lateral margin folded, anterior third with a granulosely sclerotized, rugulose, semiglobular diverticulum. Cervix bursae large, conical, sclerotized, bearing some fine crests and ribs, corpus bursae ovoid, membranous, with a narrow, long signum-stripe.

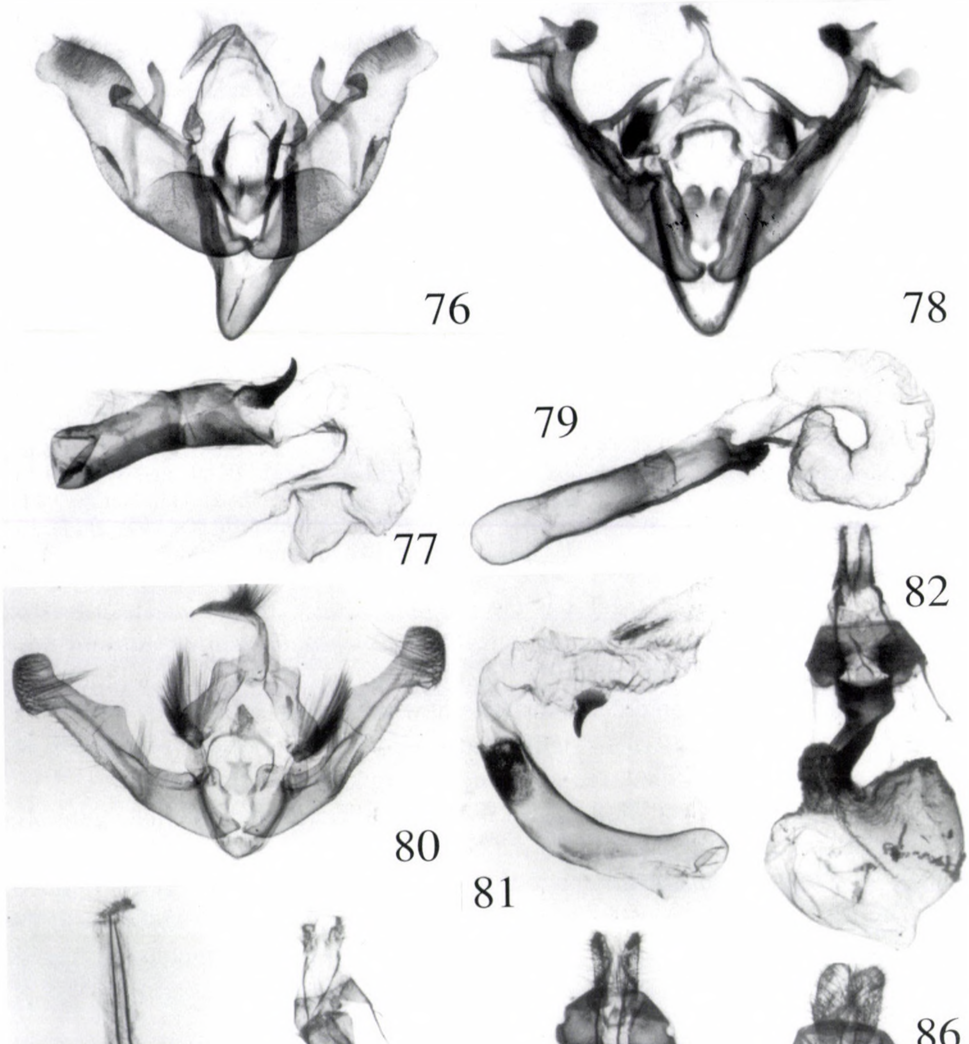
Estagrotis tibori HREBLAY et RONKAY, 1997 (Figs 85, 167)

Material examined: short series: TAIWAN, Prov. Nantou, 5 km SW of Tayuling, 2900 m, 1., 7–8. & 18. XI. 1996, 121°17'E, 24°09'N, leg. T. CSŐVÁRI & CS. SZABÓKY; 5 km N Shihmen, Hohuan-Pass, 3000 m, 13.X.1996, leg. GY. FÁBIÁN & F. NEMES (colls CSŐVÁRI, FÁBIÁN, HREBLAY, SZABÓKY).

Slide Nos HM9364 (male) HM9365, HM9731 (females).

Taxonomic notes: the species was described recently (HREBLAY & RONKAY 1997) on the basis of a single male. The new expeditions to Taiwan resulted in additional material of the species, including both sexes. The female genitalia are described and illustrated here.

Figs 76–86. 76–77 = *Telorta shenhornyeni* sp. n., holotype; 78–79 = *Agrochola albirena chihtuana* (CHANG, 1991); 80–81 = *Potnyctycia cristifera* sp. n., paratype; 82 = *Himalistra soluta* sp. n., holotype; 83 = *Hyalobole kononenkoi* HREBLAY et RONKAY, 1997; 84 = *Teratoglaea pacifica* SUGI, 1958; 85 = *Estagrotis tibori* HREBLAY et RONKAY, 1997; 86 = *Potnyctycia cristifera* sp. n., paratype


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Female genitalia (Fig. 85): ovipositor short, posterior papillae anales narrow, weak, anterior papillae forming a strong, broad plate ventrally; gonapophyses fine, slender. Ostium bursae broad, trapezoidal, heavily sclerotized, fused with anterior plate of ovipositor; caudal end of ostium with a fine medial incision. Ductus bursae medium-long, tubular, sclerotized, anterior part with granulosely sclerotized wrinkles. Cervix bursae elongated, medial third dilated, sclerotized, ribbed, apical third membranous, ductus seminalis broadly tubular. Corpus bursae discoidal, membranous, without signa.

Potnyctycia cristifera sp. n.
(Figs 80, 81, 86, 162, 163)

Holotype: male, "TAIWAN, Prov. Nantou, 5 km SW of Tayüling, 2900 m, 7–8. XI. 1996, 121°17'E, 24°09'N, leg. T. Csővári & Cs. Szabóky" (coll. FÁBIÁN).

Paratypes: Taiwan. Prov. Nantou: 3 m, with the same data as the holotype, (coll. CSŐVÁRI, HREBLAY); 1 f, 3 km SW of Tsuifeng, 2100 m, 10. II. 1997, 121°10'E, 24°06'N, leg. S. SIMONYI & P. STÉGER (coll. HREBLAY); 1 m, Wushe, 28–29.XII.1994, leg. LIN & YANG (coll. Nat. Sci. Museum, Taichung). Prov. Ilan: 5 males, 1 female, Szuyuan-Yakou, 1800 m, 23.XI.1996, leg. H. KOBAYASHI (coll. KOBAYASHI). Slide Nos HM9381, HM9384, RL5769 (males), HM9775 (female).

Diagnosis: the new species is closely related to *P. obsoleta* HREBLAY et RONKAY, 1997, the differences are as follows: *P. cristifera* shows no conspicuous sexual dimophism, the female is only slightly larger than the male, their colouration and wing pattern are similar. The new species is larger in size, the forewing is broader, its pattern is significantly stronger, the stigmata are present, more or less fully encircled, the suborbicular light patch is much stronger, the crosslines are also sharper. The most conspicuous difference in the male genitalia of the two species is the presence of the costal lobe in *P. cristifera* which is completely missing in *P. obsoleta*; in addition, the cucullus is smaller, more rounded, etc. The female genitalia of *P. cristifera* differ from those of *P. obsoleta* in the stronger, broader ostium bursae, broader, significantly weaker ductus bursae and the considerably longer cervix bursae.

Description: wingspan 36–37 mm, length of forewing 17–18 mm. Head and thorax dark reddish brown, frons yellowish, palpi ochreous with dark grey outer side, tegulae mixed with dark grey-brown, their margins marked with blackish. Antennae of male with pectination-like, long cilia. Abdomen brownish grey, dorsal crest. Forewing elongated, rather high, with apex acute, outer margin slightly crenulate. Ground colour glossy, dark ochreous-brown, sparsely irrorated with dark brown and yellowish, especially in inner half of marginal field. Ante- and postmedial crosslines less distinct, strongly sinuous, defined by dark brown and a few blackish. Medial line weak, diffuse, grey-brown, subterminal indistinct, ochreous, defined by diffuse brownish patches at outer side; terminal line a row of blackish spots. Stigmata present, orbicular flattened, oblique, pale ochreous with brownish centre, suborbicular patch large, marked with blackish brown at lower third. Reniform lunulate, encircled with whitish, marked also with some blackish brown spots, filled with brown. Claviform small, more or less rounded, its outline blackish. Hindwing shining whitish-ochreous, suffused with brownish-grey, veins and marginal area somewhat darker brown, discal spot large, lunulate, transverse line a diffuse shadow. Terminal line brown, cilia ochreous with

brownish inner line. Underside of wings pale ochreous, irrorated with brown, discal spots and transverse lines present, darker brown.

Male genitalia (Figs 80, 81): uncus rather short but strong, curved, tegumen low, wide, penicular lobes narrow, densely setose. Fultura inferior relatively small, pentagonal, with slightly broader, crown-like apical part; vinculum very short, strong. Valva narrow, elongated, costa sclerotized, with a triangular, wide lobe at medial part. Cucullus relatively small, quadratic with more or less rounded angles, covered by sparse rows of strong setae. Sacculus short, clavus a rounded lobe, harpe reduced to its narrow basal bar, fused with ventral margin of costa. Aedeagus short, tubular, arcuate, dorsal and lateral surface of carina covered with fine spiculi, ventral plate continuing in a narrow, sclerotized bar. Vesica tubular, membranous, curved ventrally, medial part with a strong, wide-based, curved, thorn-like cornutus, terminal part scobinate, with two narrow cornuti fields consisting of short, fine spinules.

Female genitalia (Fig. 86): ovipositor short, broad, posterior papillae anales rounded, densely setose, gonapophyses slender, fine. Ostium bursae short but broad, sclerotized, ventral plate significantly larger, trapezoidal, dorsal plate a fine, sclerotized arch. Ductus bursae medium-long, broad, flattened, finely scobinate, both surfaces with stronger, smoothly sclerotized patches. Cervix bursae long, broadly tubular, wrinkled, corpus bursae small, elliptical-ovoid, with two long, fine signum-stripes.

Nyctyciomorpha plagiogramma (HAMPSON, 1906) (Fig. 161)

Material examined: a long series from Taiwan, from the following localities: Prov. Nantou: 3 km SW of Tsuifeng, 2100 m, 31. X. 1996, 121°10'E, 24°06'N; 1 km W of Tatachia peak, 2520 m, 3. XI. 1996, 120°53'E, 23°33'N; 5 km SW of Tayuling, 2900 m, 7–8. & 18. XI. 1996, 121°17'E, 24°09'N, leg. T. CSŐVÁRI & CS. SZABÓKY; Tayuling, 2550 m, 7–8. 10. 1996, leg. GY. FÁBIÁN & F. NEMES. Prov Miaoli: 49 km E of Tungshih, 2490 m, 11. XI. 1996, 121°03'E, 24°19'N, leg. T. CSŐVÁRI & CS. SZABÓKY. Prov. Taitung: Hsiangyang, Police station, 2320 m, 25–26.X, 2.XI.1996; Yakou, 2600 m, 1–3.XI.1996, leg. GY. FÁBIÁN & F. NEMES. Prov. Taichung: An-ma-Shan, Hooping, 2000 m, 31.X.1996, leg. GY. FÁBIÁN & F. NEMES (colls CSŐVÁRI, FÁBIÁN, HREBLAY, SZABÓKY).

Slide Nos HM9394, HM9726, HM9729 (males), HM9390 (female).

Remarks: the species is known as a typical member of the late autumnal fauna of the southern Himalayan region, the easternmost known locality is rather distant from Taiwan. The Taiwanese populations, however, show no significant differences compared with those from Himalayas. First record from Taiwan.

Teratoglaea pacifica SUGI, 1958 (Figs 84, 165)

Material examined: 1 f, Taiwan, Prov. Nantou, 5 km SW of Tayüling, 2900 m, 7–8. XI. 1996, 121°17'E, 24°09'N, leg. T. CSŐVÁRI & CS. SZABÓKY, slide No. HM9388 (coll. HREBLAY).

Remarks: First record from Taiwan.

Agrochola albirena BOURSIN, 1956

Type material examined: holotype: "Canton, Südchina, 14. 1. 24. H. Höne" (coll. MAK, Bonn) Slide No. BOURSIN Hö: 472.

Agrochola albirena chihtuana (CHANG, 1991) **stat. rev.** (Figs 78, 79)

Material examined: TAIWAN, Prov. Nantou: 5 m, 5 km SW of Tayüling, 2900 m, 7–8. & 18. XI. 1996, 121°17'E, 24°09'N, 5 m, 1 f, 3 km SW of Tsuifeng, 2100 m, 17. XI. 1996 & 10. II. 1997, 121°10'E, 24°06'N, leg. T. CSŐVÁRI, CS. SZABÓKY, S. SIMONYI & P. STÉGER (coll. HREBLAY).

Slide Nos HM9376 (male) HM9710 (female).

Remarks. CHANG (1991) has not dealt with the closest taxon *Agrochola albirena* BOURSIN, 1956 in describing *Conistra chihtuana* CHANG, 1991. SUGI (1992) placed this taxon in the genus *Agrochola* HÜBNER [1821] and treated it as a synonym of *A. albirena*. The two taxa are very close to each other, but differ in some features of the male genitalia, therefore *chihtuana* is considered as a geographical subspecies of the species. The fultura inferior of *A. chihtuana* is more rounded, the process of harpe is somewhat narrower and longer, the shape of carina is also slightly different.

Telorta shenhornyeni RONKAY et KOBAYASHI sp. n. (Figs 74, 76, 77, 168, 169)

Holotype: male, "Taiwan, Prov. Taitung, Hsiangyang, Police station, 2320 m, 2.XI.1996, leg. Gy. Fábián & F. Nemes"; slide No. RL5826 (coll. FÁBIÁN).

Paratypes: Taiwan. Prov. Taitung: 13 m, 15 f, with the same data as the holotype; 18 m, 15 f, from the same locality, 19–20.X., 25–26.X.1996; 1 f, Yakou, 2600 m, 1–3.XI.1996, leg. GY. FÁBIÁN & F. NEMES. Prov. Nantou: 1 m, 1 f, 3 km SW of Tsuifeng, 2100 m, 17. XI. 1996, 121°10'E, 24°06'N, leg. T. CSŐVÁRI & CS. SZABÓKY (coll. Mus. Univ. Sun-Yat Sen, Kaohsiung, FÁBIÁN and HREBLAY); 2 females, Prov. Ilan, Suyuanyakou, 1800 m, 10.XII.1993, leg. H. KOBAYASHI (coll. National Science Museum, Tokyo and H. KOBAYASHI).

Slide Nos HM9702 (male), HM9703, RL5844, No. 630 KOBAYASHI (females).

Diagnosis: the new species belongs to the *T. acuminata* (BUTLER, 1878) species-group while the two previously known Taiwanese *Telorta* WARREN, 1910 species are members of the *T. divergens* (BUTLER, 1879)-group. The closest relative of the new species is *T. acuminata*, although the outer margin of the forewing is not dentated and the colouration of the wings is much lighter, more vivid, the forewing is regularly orange-yellowish, the hindwing is also more ochreous with significantly weaker dark grey-brownish suffusion. On the other hand, the

genitalia of both sexes have the same ground plan, with several specific differences. The male genitalia of *T. shenhornyeni* have shorter, apically curved valva with more acute apex and reduced, smooth clavus, broader fultura inferior with shorter, stronger lateral arms, significantly shorter (about half as long) harpe, much smaller costal crest, but with a stronger sclerotized lobe along ventral margin, much longer, stronger spine on the carina penis but with weaker, shorter cornuti in the vesica, etc. In the female genitalia the new species has much smaller ostium bursae of different shape, stronger sclerotization of the ductus bursae and the signum-stripe is considerably longer (about twice as long as in *T. acuminata*).

Comparing the new species with the other known members of the genus, *T. shenhornyeni* differs externally from *T. edentata* (LEECH, 1889) in the darker, more unicolorous ground colour, sharper, more converging crosslines, darker stigmata, etc., and the two sexes are similar, not as dimorphic as *T. edentata*. The new species differs from *T. yazakii* YOSHIMOTO, 1987, and *T. obscura* YOSHIMOTO, 1987, in the lighter colouration, sharper, double crosslines and the filling of the stigmata which is darker than ground colour.

Description: wingspan 32–34 mm, length of forewing 16–17 mm. Head and thorax dark reddish brown, palpi more reddish, tegulae mixed with dark brown, prothoracic crest well-developed. Antennae filiform in both sexes; abdomen paler, brownish grey. Forewing rather shortly triangular with apex acute, outer margin slightly concave below apex. Ground colour shining, dark red-brown, sparsely irrorated with greyish, medial area with stronger ochreous covering, especially around stigmata. Ante- and postmedial crosslines sharply defined, straight, oblique, converging to inner margin. Both crosslines double, ochreous and reddish, medial line a diffuse, dark brownish grey stripe. Subterminal rather indistinct, sinuous, ochreous, terminal line fine, ochreous, marked with dark brown triangles. Orbicular and reniform stigmata large, rounded-elliptical, encircled with ochreous and reddish, filled with dark fumous grey; claviform absent. Costa reddish, veins finely covered with ochreous, cilia dark brownish grey with obsolescent, fine ochreous medial line. Hindwing glossy, dark yellowish, with variably strong brownish grey suffusion which may almost completely cover ground colour, except costal part and a narrow stripe along outer margin. Terminal line ochreous, cilia orange-brownish. Underside of wings pale greyish-ochreous, suffused with orange-brown and irrorated with darker grey-brown, shadows of discal spots and transverse lines usually present but diffuse.

Male genitalia (Figs 76, 77): uncus relatively short, slender, pointed, tegumen narrow, penicular lobes small. Fultura inferior large, sclerotized, cordiform with small medial crest and long, more or less straight, horn-like lateral extensions; vinculum large, V-shaped. Valvae symmetric, rather short, basally broad, apically slightly tapering, finely curved ventrally below apex. Cucullus quadrangular, apex with a fine, triangular peak, costal part densely setose; corona absent. Sacculus short, rounded, clavus reduced, ventral margin with a sclerotized, short crest besides basal plate of harpe. Harpe strong, rather thick, moderately long, arcuate, with apex pointed, costal extension sclerotized, short, apically rounded. Aedeagus thick, cylindrical, carina with a large, curved, acute dorsal thorn. Vesica broadly tubular, recurved ventro-laterally. Basal half mostly membranous, distal half scobinate, with a large, subconical terminal diverticulum and a narrow, dentated terminal crest.

Female genitalia (Fig. 74): ovipositor long, narrow, posterior papillae anales elongated, weak, gonapophyses long, slender. Ostium bursae heavily sclerotized relatively large, ventral plate cordiform, with stronger lateral margins and rounded, prominent anterior edge, dorsal plate with strong, broad but short, quadratic, medially finely incised lamina. Ductus bursae medium-long, flattened, wide, proximally slightly tapering. Posterior third granulosely sclerotized, anterior part with

fine scobination and a sclerotized, wrinkled medial fold running from right edge to cervix bursae. Cervix small, rounded, rugulose with finely sclerotized wrinkles. Corpus bursae saccate, big, membranous, with a long, strong, longitudinal signum-stripe.

Bionomics and distribution: the new species is rather frequent in the higher forest regions of Taiwan.

Remarks: the new species is dedicated to Dr SHEN-HORN YEN (Taipei), a talented young Taiwanese lepidopterist.

Telorta atrifusa HREBLAY et KOBAYASHI sp. n. (Figs 75, 170, 171, 188)

Holotype: female, Taiwan, Prov. Nantou, 2550 m, Tayuling, 27.II.1996, leg. GY. FÁBIÁN & F. NEMES, slide No. RL5696 (coll. FÁBIÁN).

Paratypes: Taiwan. Prov. Nantou: 2 f, 3 km SW of Tsuifeng, 2100 m, 10. II. 1997, 121°10'E, 24°06'N, leg. S. SIMONYI & P. STÉGER (coll. HREBLAY); 1 m, Prov. Nantou, Jen-ai, Meifeng, 2100 m, 26.XI.1995, leg. M. OWADA (coll. NSM Tokyo).
Slide Nos 714 (KOBAYASHI) (male), HM9771 (female).

Diagnosis: the new species is rather remote from the other lineages of the genus, differing from both species groups known from Taiwan. The most conspicuous external difference between them is the more or less arcuate antemedial line which is straight, oblique in the other members of the genus; in addition, it differs from all related taxa by its very dark colouration of both wings, the relatively paler outer part of marginal area, the strong dark spots of the subterminal line and the the features of the female genitalia. The male genitalia of *T. atrifusa* differ very strongly from those of the related taxa by its bifid harpe, flat, large, shield-like fultura inferior having no crest or extensions. The aedeagus and the vesica resemble to those of *T. shenhornyeni* but having a long, pointed terminal cornutus. The female genitalia differ from those of the species of the *divergens*-group in the shorter ovipositor, the lack of the double-peaked caudal extension of the ostium bursae, the short but broad, heavily sclerotized, calyculate ductus bursae and the very strong crest of the cervix; the corpus bursae has four long, ribbon-like signa with irregular, stronger, broader patches. The female genitalia of the taxa of the *acuminata*-group have smaller, rounded ostium, significantly longer, less sclerotized ductus bursae, smaller cervix without heavily sclerotized part, the corpus bursae has a single, longitudinal, strongly sclerotized signum-stripe. The last member of the genus, *T. edentata* has very long, weak ovipositor, triangular-trapezoidal, sclerotized ostium bursae, short, narrow, sclerotized ductus bursae with sclerotized anterior laminae running into cervix bursae and the corpus bursae is ovoid, membranous, and without signa.

Description: wingspan 33 mm, length of forewing 16 mm. Head and thorax dark chocolate-brown mixed with fumous grey, palpi greyish with blackish tips. Antennae of female filiform. Abdomen slightly paler, fumous grey. Forewing rather shortly triangular with apex acute, outer margin slightly concave below apex. Ground colour glossy, dark grey-brown, sparsely irrorated with greyish, outer half of marginal area much paler greyish. Base of wing with blackish-brown irroration, ante- and postmedial crosslines less distinct, double, dark grey-brown filled with pale ochreous. Antemedial evenly arcuate, postmedial almost straight, slightly angled inwards near inner margin; medial line obsolete, dark brownish grey stripe. Subterminal interrupted, diffuse, strongly sinuous, pale ochreous, marked with blackish spots between veins and a dark costal patch, terminal line fine, ochreous, marked with dark brown triangles. Orbicular and reniform stigmata hardly visible, incompletely encircled with ochreous scales, reniform with a blackish-brown spot at lower third; claviform absent. Costa blackish grey, cilia dark grey. Hindwing shining, almost unicolorous blackish grey, inner area only slightly paler. Terminal line ochreous, cilia dark grey. Underside of wings dark fumous grey, with darker submarginal stripe on both wings, discal spot of forewing absent, that of hindwing diffuse but present.

Male genitalia (Fig. 188): uncus relatively short, slender, pointed, tegumen short, wide, penicular lobes small. Fultura inferior large, sclerotized, shield-like; vinculum large, V-shaped. Valvae almost symmetric, rather short, basally broad, apically tapering; cucullus narrow, small, triangular with apex pointed. Sacculus elongated, sclerotized, clavus reduced, saccular process long, strong, flattened, arcuate with rounded apex. Harpe strong, rather thick, bifurcated with longer costal process, costal extension long, strong, cuneate with acute, slightly curved apically. Aedeagus thick, short, cylindrical, carina with a large, curved, acute dorso-lateral thorn. Vesica broadly tubular, recurved ventro-laterally, with a long, pointed terminal cornutus.

Female genitalia (Fig. 75): ovipositor moderately long, conical, posterior papillae long, pointed, anterior papillae short, broad, sclerotized; gonapophyses rather long. Ostium bursae large, heavily sclerotized, more or less quadratic with arcuate anterior edge, ductus bursae short, broad, asymmetrically calyculate, strongly sclerotized, connected to ostium with a weaker but broad neck. Cervix bursae large, strongly rugulose, with a large, twisted, heavily sclerotized plate. Corpus bursae large, discoidal, membranous, with four long, ribbon-like, partly strongly sclerotized signa.

Bionomics and distribution: the few known female specimens of the species were collected at the end of February, the first record of the "overwintering" of a *Telorta* species as adult.

Hyalobole kononenkoi Hreblay et Ronkay, 1997 (Fig. 83)

Material examined: a series of specimens from Taiwan, from the following sites: Prov. Taitung: Hsiangyang, Police station, 2320 m, 25–26.X., 2.XI.1996; Yakou, 2600 m, 1–3.XI.1996, leg. Gy. Fábián & F. Nemes. Prov. Nantou: Tayuling, 2550 m, 7–8. 10. 1996, leg. Gy. Fábián & F. Nemes; 5 km SW of Tayuling, 2900 m, 1. & 18. XI. 1996, 121°17'E, 24°09'N; 1 km W of Tatachia peak, 2520 m, 3. XI. 1996, 120°53'E, 23°33'N, leg. T. Csővári & Cs. Szabóky. Prov Miaoli, 49 km E of Tungshih, 2490 m, 11. XI. 1996, 121°03'E, 24°19'N, leg. T. Csővári & Cs. Szabóky (colls Csővári, Fábián, Hreblay, Szabóky).

Slide Nos HM9732 (male), HM9724, HM9725, RL5827 (females).

Taxonomic notes: a recently described species (Hreblay & Ronkay 1997), the type series containing only the male sex. Additional, extensive materi-

al was obtained in October-November, including also females. The female genitalia are here described and illustrated.

Female genitalia (Fig. 83): ovipositor very long, narrow, posterior papillae anales fine, conical, gonapophyses very long. Ostium bursae a fine, sclerotized arch, fused with ductus bursae. Ductus bursae flattened, slightly tapering proximally. Both surfaces granulosely sclerotized, dorsal surface with stronger patches and a short, wrinkled lamina at junction to cervix bursae. Cervix bursae large, rounded, gelatinous, ventral surface with fine sclerotization. Corpus bursae rather small, sacculiform, membranous with fine wrinkles.

Bionomics and distribution: the species was collected in a relatively low numbers in different parts of the island, everywhere in the higher forest zones. All specimens were found in autumn, no overwintering examples are known.

Xanthia melonina opipara CHANG, 1991, **stat. n.**

Material examined: Taiwan. Prov. Shinjwu: 1 f, Guenwuh, 1730 m, 10.XII.1991, leg. SHYU (Nat. Sci. Museum, Taichung). Prov. Taitung: 1 m, Hsiangyang, Police station, 2320 m, 25–26.X.1996, leg. GY. FÁBIÁN & F. NEMES (coll. FÁBIÁN).

Slide Nos RL5931 (male), RL5771 (female).

Taxonomic notes: the Taiwanese populations of *X. melonina*, described originally as a full species, show only slight differences in the external and the genital features, as compared with the nominate *X. melonina*, distributed widely in the southern Himalayan region. The main difference between them lie in the shape of the cucullus which is narrower, more acute in *opipara*, in addition, the cornuti field of the vesica is slightly different. This scale of differences is significantly smaller than in case of the other lineage of the Himalayan-Taiwanese *Xanthia* species, *X. tatachana* and *X. aculeata* (see below), therefore *opipara* is considered as the insular subspecies of *X. melonina*.

Xanthia tatachana CHANG, 1991
(Figs 67, 68, 72)

Material examined: Taiwan. Prov. Taitung: 2 m, 1 f, Hsiangyang, 25–26.X., 2.XI.1996, leg. FÁBIÁN & NEMES. Prov. Nantou: 2 m, 1 f, 3 km SW of Tsuifeng, 2100 m, 31. & 17. X. 1996, 121°10'E, 24°06'N, leg. T. CSŐVÁRI & CS. SZABÓKY. Prov Miaoli: 1 m, 1 f, 49 km E of Tungshih, 2490 m, 11. XI. 1996, 121°03'E, 24°19'N, leg. T. CSŐVÁRI & CS. SZABÓKY (colls CSŐVÁRI, FÁBIÁN, HREBLAY, SZABÓKY).

Slide Nos HM9354 (male) HM9390, RL5828 (females).

Taxonomic notes: the Taiwanese sister species of *X. aculeata* HREBLAY et RONKAY, 1997 (Figs 69, 70). The male genitalia are similar to those of *X. aculeata*: the differences are as follows: the basal plate of the fultura inferior is much

bigger in *X. tatachana* (Figs 67, 68), but the apical process is shorter, the cucullus is narrower, more elongated, the subapical costal spine is longer, less acute, the harpe is much finer, longer, the subbasal cornutus of the vesica is stronger, basally curved, its bulb larger, the distal part of the vesica bearing a spinulose field which is completely missing in *X. aculeata*.

The female genitalia of *X. tatachana* (Fig. 72) differ from those of *X. aculeata* (Fig. 73) by its narrower ostium bursae with a small sclerotized ventral lobe at caudal edge but without large, sclerotized, quadrangular ventral plate, weaker, more granulose sclerotization of ductus bursae, smaller, less sclerotized cervical part of bursa copulatrix and shorter signa; the last sternite has significantly broader, deeper apical incision.

Atrachea (s. l.) taiwana (CHANG, 1991) **comb. n.**
(Figs 87, 88)

Material examined: Taiwan. Prov. Nantou: 2 m, Wushe, 28–29.XII.1994, leg. LIN & YANG (coll. Nat. Sci. Museum, Taichung). Prov. Taitung: 1 m, 3 f, Hsiangyang, Police station, 2320 m, 25–26.X, 2.XI.1996; 1 m, 1 f, 2 km S Liyusan, 1760 m, 21.X.1996, leg. GY. FÁBIÁN & F. NEMES (coll. FÁBIÁN). Slide No. RL5768 (male).

Taxonomic notes. The species is relatively far from any *Antivaleria* SUGI, 1980 taxa, displaying only some slight superficial resemblamce. The genital configuration of both sexes show closer connections with some Inner Asian *Atrachea* species, therefore it is transferred provisionally to this genus. A revision of the genus *Atrachea* would be highly desirable.

Apamea aquila substriata ssp. n.
(Figs 89, 90, 95, 172)

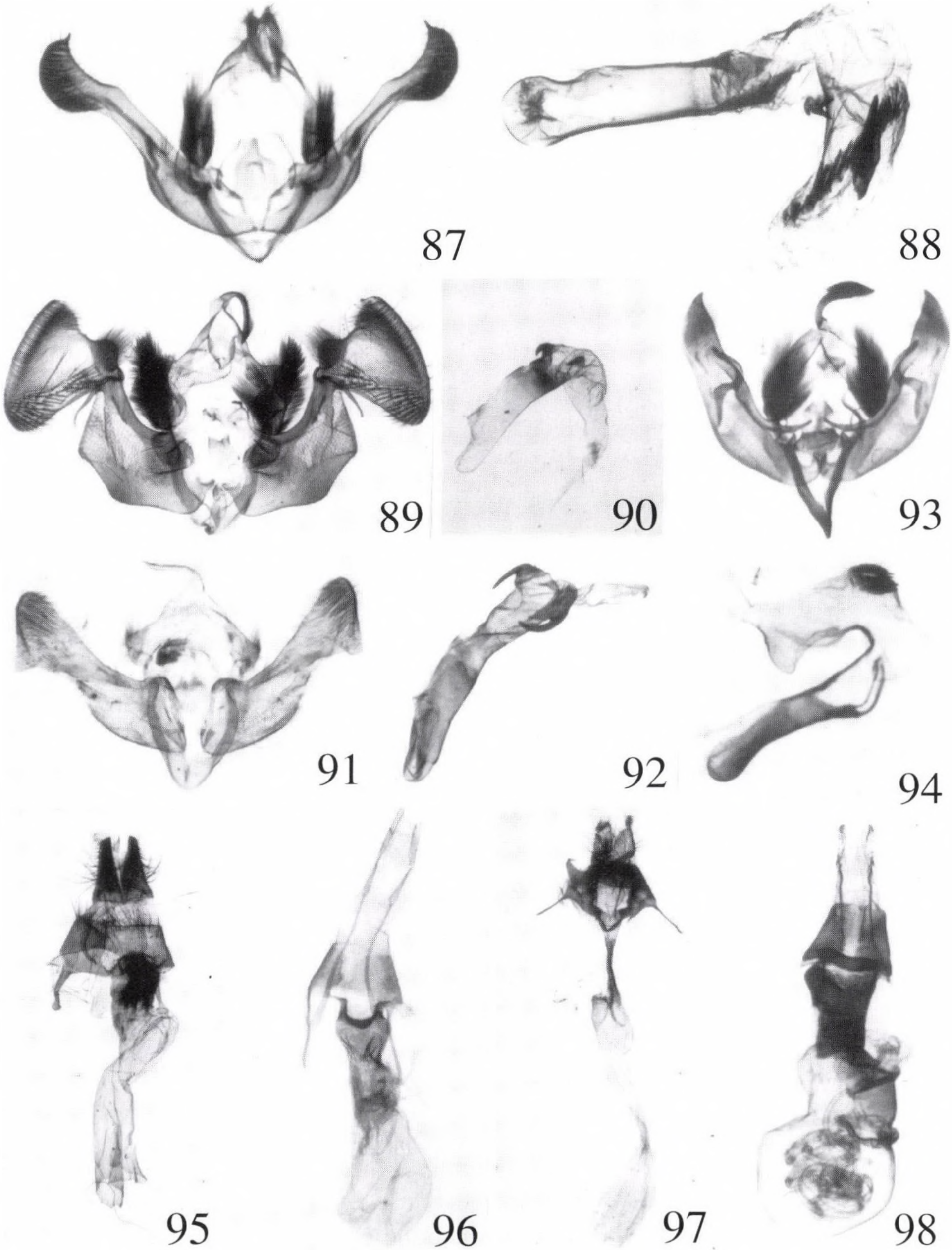
Holotype: male, "TAIWAN, Prov. Nantou, 5 km SW of Tayüling, 2900 m, 6. VIII. 1996, 121°17'E, 24°09'N, leg. T. Csővári & L. Mikus", slide No. HM9328 (coll. HREBLAY).

Paratypes: Taiwan. Prov. Nantou: 10 m, 4 f, with the same data as the holotype; 2 m, 1 f, 3 km SW of Tsuifeng, 2100 m, 4–5. & 7. VIII. 1996, 121°10'E, 24°06'N; 3 m, 3 f, 7 km SW of Tayuling, 3000 m, 19. VIII. 1996, 121°16'E, 24°08'N, leg. T. CSŐVÁRI & L. MIKUS. Prov Miaoli: 2 m, 49 km E of Tungshih, 2490 m, 8. VIII. 1996, 121°03'E, 24°19'N, leg. T. CSŐVÁRI & L. MIKUS (colls CSŐVÁRI, HREBLAY); Prov. Taitung: 2 m, 2 km E Hsiangyang, 2200 m, 6.VII.1996, leg. G. CSORBA & L. NÉMETH (colls FÁBIÁN and HERCZIG).

Slide Nos HM9750 (male), HM9329 (female).

Diagnosis: *Apamea aquila substriata* ssp. n. is the Taiwanese subspecies of *A. aquila* DONZEL, 1837. The nominotypical *A. aquila aquila* is distributed in the western part of the Palaearctic region, since the populations occurring in the Pa-

Figs 87–98. 87–88 = *Atrachea (s. l.) taiwana* (CHANG, 1991); 89–90 = *Apamea aquila substriata* ssp. n., holotype; 91–92 = *Chortodes cornutifera* sp. n., holotype; 93–94 = *Cosmia poecila* sp. n., paratype; 95 = *A. a. substriata* ssp. n., paratype; 96 = *Oroplexia euplexina* (DRAUDT, 1950), paralectotype; 97 = *O. fortunata* sp. n., holotype; 98 = *C. poecila* sp. n., paratype



cific region represent a distinct race, *A. aquila oriens* (WARREN, 1911), described from Japan and China. *A. a. substriata* ssp. n. differs from the other geographic subspecies of *A. aquila* and from *A. a. oriens* in the somewhat narrower forewing with more reddish, clear, less irrorated colouration and sharply defined blackish pattern, resembling more to *A. striata* HARUTA, 1958. The male genitalia of the races of *A. aquila* (Figs 89, 90) are more or less identical, only the costal extension is shorter in *A. aquila substriata* ssp. n. than in the other two subspecies.

Chortodes cornutifera sp. n.
(Figs 91, 92, 173)

Holotype: male, "TAIWAN, Prov. Nantou, 7 km SW of Tayüling, 3000 m, 19. VIII. 1996, 121°16'E, 24°08'N, leg. T. Csővári & L. Mikus", slide No. HM9740 (coll. HREBLAY).

Paratypes: Taiwan. Prov. Nantou: 5 m, with the same data as the holotype, 5 m, 5 km SW of Tayuling, 2900 m, 6. VIII. 1996, 121°17'E, 24°09'N, leg. T. CSŐVÁRI & L. MIKUS; 1 m, 1 km W of Tatachia peak, 2520 m, 13. X. 1995, 120°53'E, 23°33'N, leg. T. CSŐVÁRI & P. STÉGER, (colls CSŐVÁRI, HREBLAY).
Slide No. HM9752 (male).

Diagnosis: the new species resembles externally some Chinese "*Oligia*" HÜBNER, [1821] species, mostly to *O. sodalis* DRAUDT, 1950, but the genitalia show closer affinities with *Chortodes* TUTT, 1897, than with *Oligia* or with *Photedes* LEDERER, 1857. The closest relative of *Ch. cornutifera* is *Ch. elymi* (TREITSCHKE, 1825), which has similarly rounded clavus, reduced harpe, similar shape and size of cucullus and corona, and the vesica has cornuti. *Ch. cornutifera* sp. n. differs from the other taxa of the genus in the reduced ampulla and the large, claw-like pair of cornuti. Another, externally somewhat similar species is *Ch. minima* (HAWORTH, 1809), but it is regularly smaller in size, ground colour of the forewing is ochreous- or reddish-brown, not ashy grey and the dark pattern is more indistinct.

Description: wingspan 28–33 mm, length of forewing 14–16 mm. Head pale grey, outer side of palpi blackish, frons, collar, tegulae and thorax whitish-grey; abdomen somewhat more brownish. Antennae of male filiform. Forewing glossy, deep ashy grey, medial field irrorated with a few ochreous scales; costa spotted with whitish. Subbasal, antemedial and postmedian lines black(ish), fine, sinuous, medial line a pale, diffuse shadow. Orbicular and reniform stigmata relatively large, rounded, incompletely encircled with fine blackish and whitish lines; claviform a small, black patch. Subterminal line diffuse, interrupted, sinuous, terminal line and cilia dark grey. Hindwing shining whitish, suffused finely with greyish, veins and transverse lines slightly darker, marginal suffusion pale, indistinct. Terminal line fine, dark grey, cilia whitish. Underside of wings whitish, forewing suffused strongly with dark grey, pattern indistinct. Hindwing much paler, discal spot and transverse line present.

Male genitalia (Figs 91, 92): uncus short, slender, weakly sclerotized, tegumen broad, low, penicular lobes more or less triangular, strongly hairy. Fultura inferior deltoidal, apical part stronger, with small incision; vinculum short, strong. Valva elongated, medially constricted, cucul-

lus large, broad, more or less triangular, setose, with apex rounded; corona present. Sacculus short, clavus a large, rounded triangular lobe. Harpe reduced to its narrow basal plate, ampulla absent. Aedeagus short, cylindrical, vesica short, broadly tubular, armed with two large, curved, claw-like cornuti.

Female unknown.

Bionomics and distribution: the species was found rarely in the high mountainous regions of Taiwan, between 2500–3000 m a.s.l. The freshly emerged moths appear in August, the flight period extending to the middle of October.

Oroplexia fortunata sp. n.
(Figs 97, 176)

Holotype: female, "TAIWAN, Prov Miaoli, 49 km E of Tungshih, 2490 m, 11.XI.1996, 121°03'E, 24°19'N, leg. T. Csővári & Cs. Szabóky", slide No. HM9391 (coll. HREBLAY).

Paratypes: Taiwan. Prov. Miaoli: 3 f, with the same data as the holotype (coll. CSŐVÁRI, HREBLAY).

Slide No. HM9722 (female).

Diagnosis: the closest relatives of *O. fortunata* are *Oroplexia variegata* HREBLAY et RONKAY, 1997 and *O. euplexina* (DRAUDT, 1950). *Oroplexia fortunata* sp. n. differs from *O. variegata* in the darker colouration, less sharply defined crosslines and stigmata and some features of the female genitalia, e.g. in the shorter ovipositor, smaller, weaker ostium bursae, longer, tubular ductus bursae and the much longer, membranous corpus bursae. The descriptions of the female genitalia of the two closely related species are given below.

Description: wingspan 36 mm, length of forewing 17 mm. Head and thorax blackish brown, mixed with a few paler greyish scales, metathoracic tuft large, whitish; antennae of male shortly bipectinate. Abdomen paler, brownish-grey, dorsal crest strong, blackish. Forewing elongated-triangular, with apex pointed, ground colour blackish brown, basal field slightly, inner half or marginal area strongly irrorated with shining, light pinkish brown. Wing pattern rather diffuse, ante- and postmedial crosslines double, less sinuous, filled partly with whitish- or pinkish grey, medial line a narrow, waved shadow. Orbicular and reniform stigmata encircled partly with blackish, reniform also with some whitish spots at outer margin, their filling somewhat paler than ground colour, marked with pinkish-brownish scales; claviform a short, blackish arch. Subterminal an interrupted, pale, pinkish-greyish line, defined by a few obsolescent, dark greyish patches. Terminal line a row of blackish spots, cilia dark brown with paler inner line. Hindwing shining whitish, suffused with grey, veins and marginal area somewhat darker, discal spot and transverse line diffuse but well discernible. Underside of both wings whitish, forewing strongly, hindwing scarcely irrorated with dark grey, discal spots and transverse lines diffuse.

Female genitalia (Fig. 97): ovipositor short, gonapophyses relatively long, slender. Ostium bursae calyculate, ventral lamina shorter, broader, dorsal plate forming a narrow, more or less V-shaped arch. Ductus bursae long, tubular, with granulosely sclerotized wrinkles. Cervix bursae tiny, with finely granulose wrinkles, corpus bursae membranous, very long, narrow, fundus slightly dilated; signa absent.

Oroplexia euplexina (DRAUDT, 1950)
(Figs 96, 174)

Type material examined: 1 male, 1 female syntypes, the male is designated here as lectotype: "Li-kiang. (China) Provinz Nord-Yuennan. 22. 9. 1935. H: Höne", Slide No. BOURSIN Hö. 531 (MAK, Bonn). Paralectotype: 1 female, Li-kiang (China), Provinz Nord-Yuennan 30. 9. 1935, H. HÖNE (MAK, Bonn).

Slide No. HM10014 (female).

Description of the female genitalia (Fig. 96): ovipositor long, relatively strong, gonapophyses long, slender. Ostium bursae a broad, strongly sclerotized, U-shaped ribbon, posterior half of ductus bursae sclerotized, flattened, distally dilated, proximal part with stronger crests and folds. Anterior half broad, gelatinous, densely wrinkled. Cervix bursae small, membranous, corpus bursae elliptical-ovoid, without signa.

Oroplexia variegata HREBLAY et RONKAY, 1997
(Fig. 175)

Material examined: the type series and several specimens of both sexes from various parts of Taiwan, October–November, 1996.

Description the female genitalia: ovipositor long, conical, gonapophyses rather strong, long. Ostium bursae sclerotized, flattened, more or less calyculate, distal edge arcuate, covered densely with minute spiculi, especially in dorsal surface. Ductus bursae broad, medial part dilated, proximal third constricted. Both surfaces wrinkled, dorso-lateral part with stronger crests. Cervix bursae tiny, wrinkled, corpus bursae elliptical, membranous, without signa.

Cosmia poecila sp. n.
(Figs 93, 94, 98, 146)

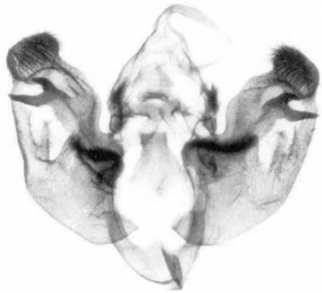
Holotype: male, "TAIWAN, Prov. Taitung, 2 km N of Tupan, 500 m, 24. X. 1995, 120°52'E, 22°29'N, leg. T. Csővári & P. Stéger", slide No. HM7928 (coll. HREBLAY).

Paratypes: Taiwan. Prov. Taitung: 1 f, with the same data as the holotype. Prov. Nantou: 5 m, 3 km SW of Tsuifeng, 2100 m, 11.X., 20.X., 26–27.X.1995, 121°10'E, 24°06'N, leg. T. CSŐVÁRI & P. STÉGER (colls CSŐVÁRI, HREBLAY); 1 m, Meimu, 2000 m, 28.X.1996, leg. GY. FÁBIÁN & F. NEMES. Prov. Taichung: 1 f, An-ma-Shan, Hooping, 2000 m, 31.X.1996, leg. GY. FÁBIÁN & F. NEMES. Prov. Taoyuan: 1 f, Ming Chyr Forest Recreation Area, 1160 m, 5–6.X.1996, leg. GY. FÁBIÁN & F. NEMES. Prov. Hualien: 1 f, Kuanyuan, 1380 m, 11–12.X.1996, leg. GY. FÁBIÁN & F. NEMES (coll. FÁBIÁN).

Slide Nos RL5842 (male), RL5843 (female).

Diagnosis: no similar species is known, and the generic placement is rather provisional. It shows some external similarities also to the members of the genus *Dyrzela* WALKER, 1858.

Figs 99–106. 99–102 = *Gortyna fortis* (BUTLER, 1878): 99–100 = Russia, Far East, 101–102 = China, P. Hunan, Hoengshan; 103–104 = *G.* sp., China, Tapaishan; 105–106 = *G. basalipunctata* (GRAESER, 1889)



99



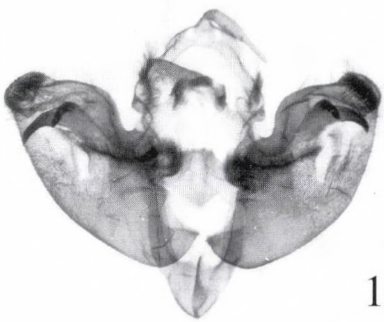
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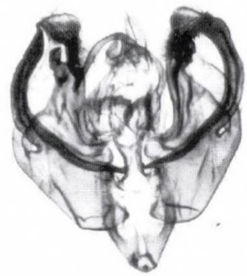
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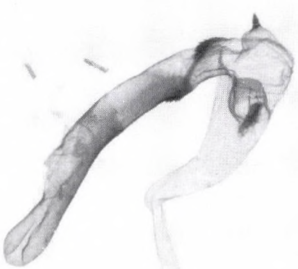
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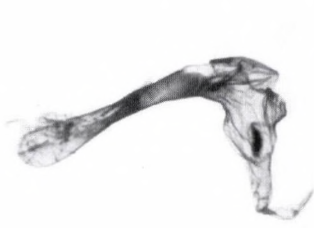
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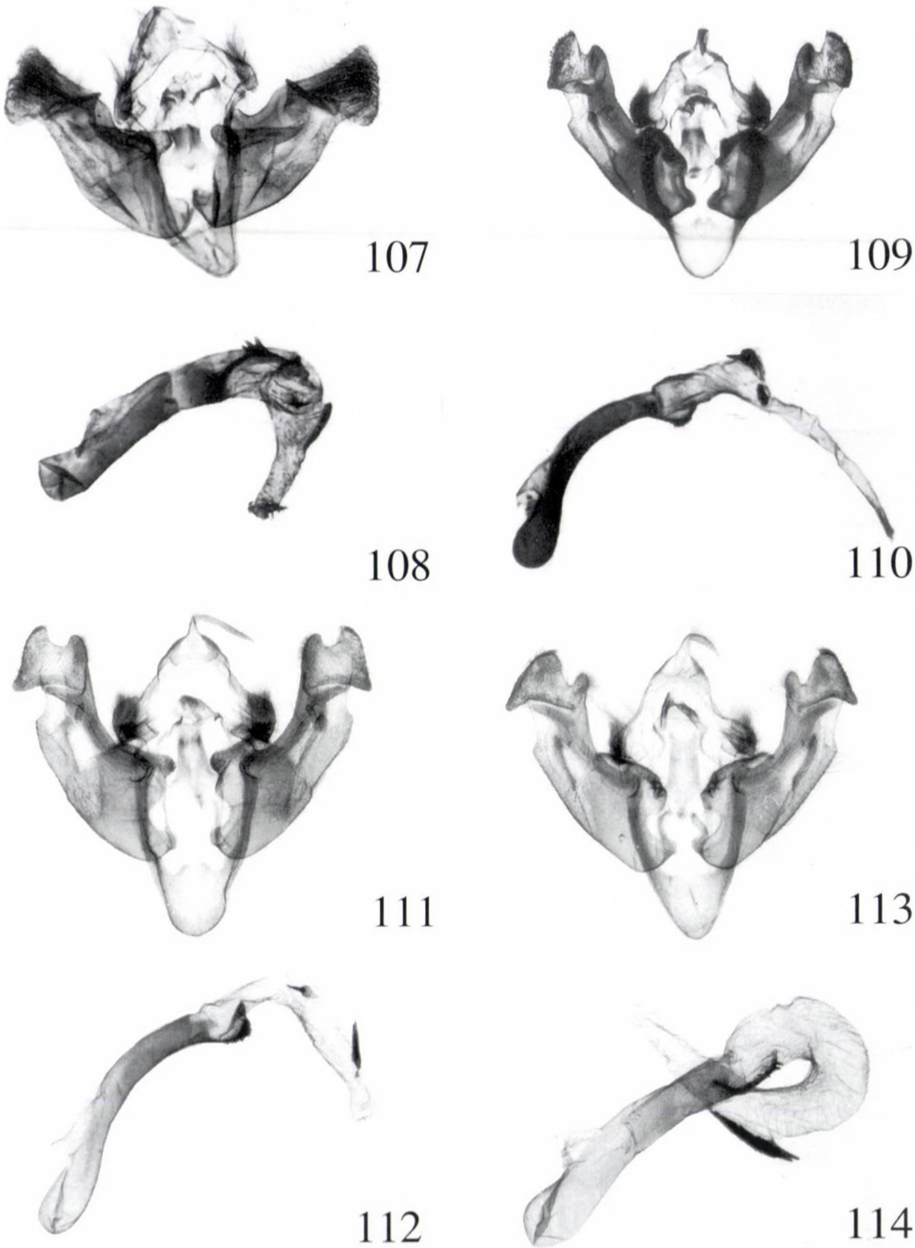


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106

Figs 107–114. 107–108 = *Gortyna flavina* sp. n., holotype; 109–110 = *G. plumbitincta* sp. n., holotype; 111–112 = *G. plumbeata* sp. n., holotype; 113–114 = *G. imitans* sp. n., holotype



Description: wingspan 25–27 mm, length of forewing 11–12 mm. Head and thorax ochreous-whitish, outer side of palpi and eyelashes blackish, tegulae mixed with ochreous-brown; abdomen somewhat more greyish. Antennae filiform in both sexes. Forewing elongated, narrow triangular, with apex finely pointed, ground colour shining whitish-ochreous, irrorated variably strongly with pinkish brown, mostly in basal and marginal areas. Wing pattern usually reduced to three bigger and two smaller black patches along costal margin, sometimes remnants of crosslines and orbicular and reniform stigmata can also be observed as ochreous-brownish spots. Hindwing ochreous, suffused variably strongly with brown, marginal suffusion and veins darker, transverse line diffuse. Underside of forewing pale ochreous-brownish, transverse line narrow, almost straight, discal spot small; costal patches pale, indistinct. Hindwing paler, transverse line and discal spot fine, marginal area darker.

Male genitalia (Figs 93, 94): uncus strong, slender, curved, tegumen broad, relatively high, penicular lobes large, densely hairy. Fultura inferior cordiform, vinculum strong, acute, V-shaped. Valva medium-long, slender, slightly curved at base, apically finely tapering. Cucullus triangular, densely hairy, with apex acute, corona present. Sacculus short, narrow, clavus reduced, harpe strong, slender, S-shaped. Aedeagus short, cylindrical, carina with two long, slender, dentated ventral bars and a stronger, longer dorsal bar. Vesica tubular, everted forward, angled strongly upwards at medial third, then recurved dorsally. Basal third membranous, with a small, conical ventral projection, medial part terminated in a large, rounded dorsal cornuti field consisting of strong spinules, distal third slightly dilated, scobinate, with a conical terminal diverticulum.

Female genitalia (Fig. 98): ovipositor medium-long, conical, posterior papillae pointed, weak, apophyses long, anterior papillae strongly sclerotized, apophyses very short. Ostium bursae a short but broad, heavily sclerotized ring, ductus bursae long, flattened, heavily sclerotized, posterior half broader, its lateral margin folded at right side. Cervix bursae sclerotized, partly folded, corpus bursae globular, scobinate, with a long, collar-like signum below cervix bursae.

Bionomics and distribution: the new species was found in low and medium high regions in Taiwan, inhabiting less disturbed forests. The specimens were collected at the mid-Autumn but most specimens are more or less worn, the flight period begins presumably at the beginning of September.

Gortyna flavina sp. n.
(Figs 107, 108, 117, 182)

Holotype: male, "Taiwan, Prov. Nantou, 1 km W of Tatachia peak, 2520 m, 13. X. 1995, 120°53'E, 23°33'N, leg. T. Csővári & P. Stéger" (coll. Fábián). Slide No. HM7910.

Paratypes: Taiwan. Prov. Taitung: 1 m, 4 f, Hsiangyang, police station, 2320 m, 19–20.X., 25–26.X.1996, leg. Gy. Fábián & F. Nemes. Prov. Hualien: 1 m, Kuanyuan, 1380 m, 11–12.X.1996, leg. Gy. Fábián & F. Nemes. Prov. Nantou: 1 m, 2 f, Tayuling, 2550 m, 7–8.X.1996, leg. Gy. Fábián & F. Nemes; 1 m, 1 f, 3 km SW of Tsuifeng, 2100 m, 11. X. 1995, 121°10'E, 24°06'N; 7 m, 2 f, 1 km W of Tatachia peak, 2520 m, 13. X. 1995, 120°53'E, 23°33'N, leg. T. Csővári & P. Stéger. Prov. Taoyuan: 1 f, 14 km E of Fuhsing, 800 m, 28. X. 1995, 121°23'E,

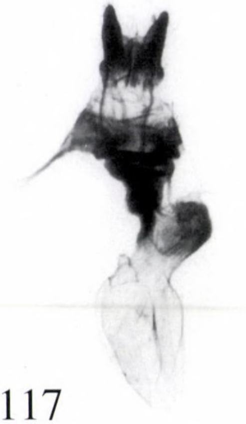
Figs 115–123. 115 = *Gortyna fortis* (Butler, 1878), Japan; 116 = *G. basalipunctata* (Graeser, 1889), Japan; 117 = *G. flavina* sp. n., paratype; 118 = *G. plumbitincta* sp. n., paratype; 119 = *G. plumbeata* sp. n., paratype; 120 = *G. imitans* sp. n., paratype; 121 = *Amphipyra monochroma* Yoshimoto, 1994; 122 = *A. averna* sp. n., holotype; 123 = *A. charon* Draudt, 1950



115



116



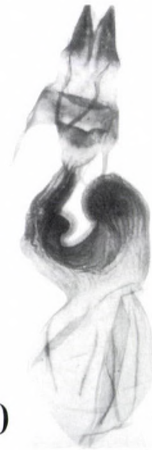
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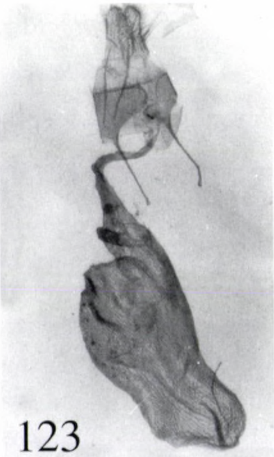
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122



123

24°50'N, leg. T. CSŐVÁRI & P. STÉGER (colls Mus. Univ. Sun-Yat Sen, Kaohsiung, CSŐVÁRI, FÁBIÁN, HREBLAY, PLANTE).

Slide No. HM9746 (female).

Diagnosis: as *G. fortis* (BUTLER, 1878) (Figs 99–102, 115) but is larger in size, the forewing ground colour is darker, more orange-ochreous, having stronger golden-brownish irroration; in some cases the specimens of the two species are hardly separable by their external features. On the other hand, the genitalia of both sexes are surprisingly different. The male genitalia of *G. flavina* have different shape of valva, clavus, costal process and cucullus, bigger teeth of carina and stronger terminal cornnuti field; in the female genitalia the new species has shorter ostium bursae without large, double caudal lobe and shorter but broader ductus bursae.

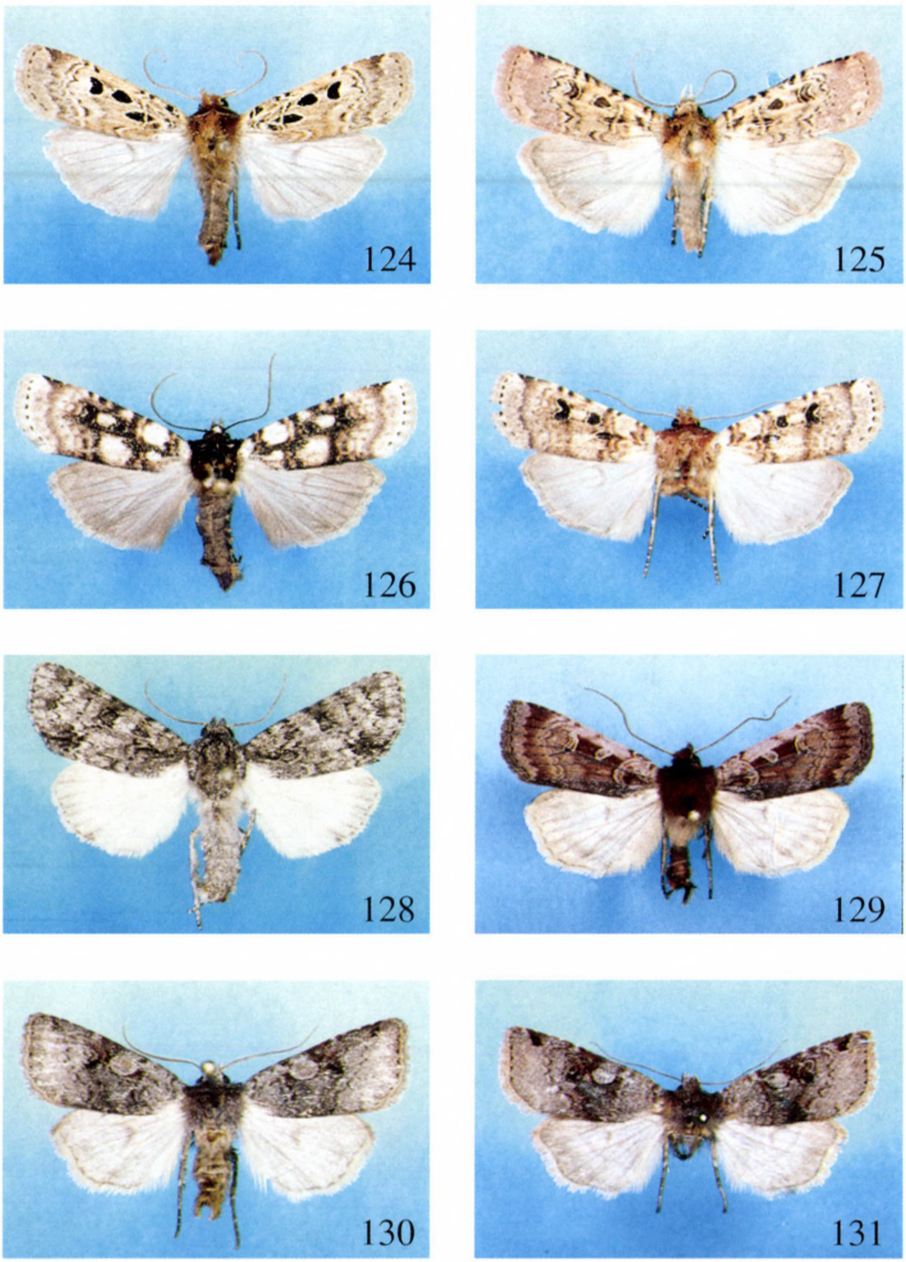
Description: wingspan 39–43 mm, length of forewing 18–21 mm. Head and thorax brownish, collar and tegulae mixed with ochreous-orange, antennae filiform in both sexes. Abdomen paler, ochreous grey, dorsal crest reduced to a few small tufts. Forewing high, broadly triangular with apex acute, outer margin concave below apex. Ground colour deep ochreous-orange with some golden shining, medial field irrorated with ochreous brown, outer part of basal field and marginal field suffused with darker brown and bluish-greyish. Veins covered with brownish grey, apical patch golden-ochreous. Basal spot pale ochreous, subbasal line short, double, arcuate. Ante- and postmedial lines double, former oblique, sinuous, strongly angled inwards at claviform spot, then outwards to inner margin. Medial line a pale, diffuse, sinuous, brown stripe, postmedial line less sinuous, inner line rather diffuse, pale, outer line much stronger, greyish brown. Orbicular big, rounded, reniform elliptical, both encircled with dark brown, reniform marked also with some ochreous spots. Claviform small, represented by a fine, more or less pointed brownish arch. Subterminal more or less continuous, rather diffuse, ochreous, defined by a darker greyish inner shadow. Terminal line dark brown, cilia darker, grey-brown. Hindwing suffused with dark brownish grey, inner area only slightly lighter, veins and discal spot somewhat darker. Underside of wings whitish, forewing and marginal area of hindwing strongly suffused with dark brown-grey, discal spots and transverse lines present, rather diffuse on both wings.

Male genitalia (Figs 107, 108): uncus short, slender, with apex pointed, tegumen low, wide, penicular lobes small, narrow. Fultura inferior deltoidal with broader apical part, vinculum short, strong, V-shaped. Valva rather short, constricted below apex, cucullus triangular, corona present. Clavus a long, broad crest with rounded inner extremity, covered by fine setae. Costal process a wide, flattened, sclerotized, slightly bifurcate but apically rounded plate; harpe and ampulla absent. Aedeagus short, cylindrical, carina with a narrow ventro-lateral bar,terminated in a large, dentated crest. Vesica short, curved ventrally, bearing a small medial diverticulum armed with a cornutus, terminal part with a narrow cornuti field consisting of fine spiculi.

Female genitalia (Fig. 117): ovipositor strong, acute, gonapophyses strong. Ostium bursae short, wide, quadrangular, sclerotized, ductus bursae short, broad, proximally tapering, ribbed and granulosely sclerotized, distal part with a sclerotized pocket. Cervix bursae rounded, ribbed, finely sclerotized, corpus bursae elliptical, with a signum.

Remarks: we have studied several specimens of *G. fortis* from various localities of the eastern Pacific region incl. Russia, Korea, Japan and China. The externally often strongly different specimens show a rather high conformity in the configuration of their genitalia, with the exception of a single male specimen

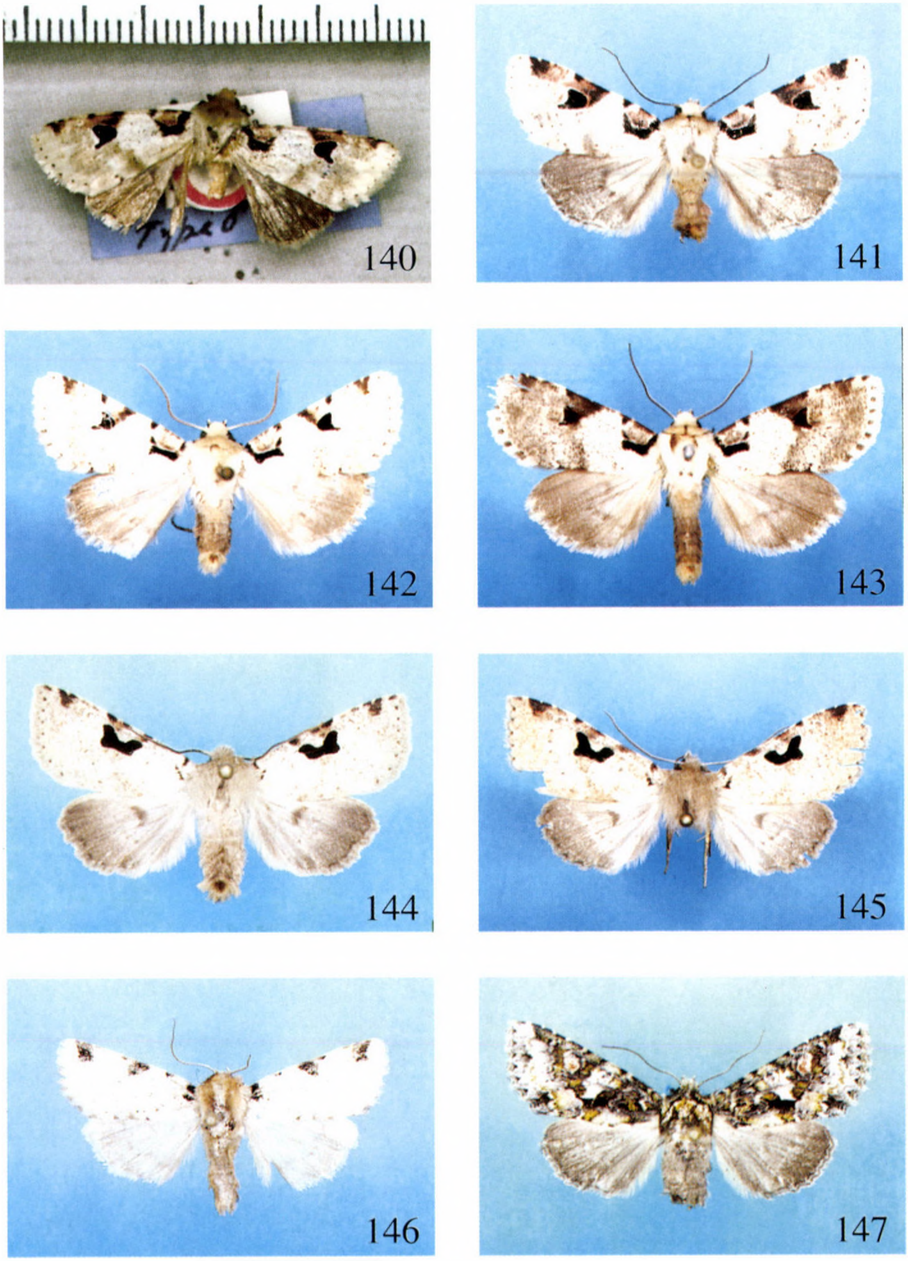
Figs 124–131. 124 = *Hermonassa formontana* sp. n., holotype; 125 = *H. inconstans* WILEMAN, 1914; 126 = *H. legraini* PLANTE, 1994, Taiwan; 127 = *H. plantei* sp. n., holotype; 128 = *Plataplecta pulverosa taitungensis* ssp. n., holotype; 129 = *Pseudohermonassa* sp. Taiwan; 130–131 = *Cerastis griseiorbis* sp. n.: 130 = holotype, 131 = paratype, female



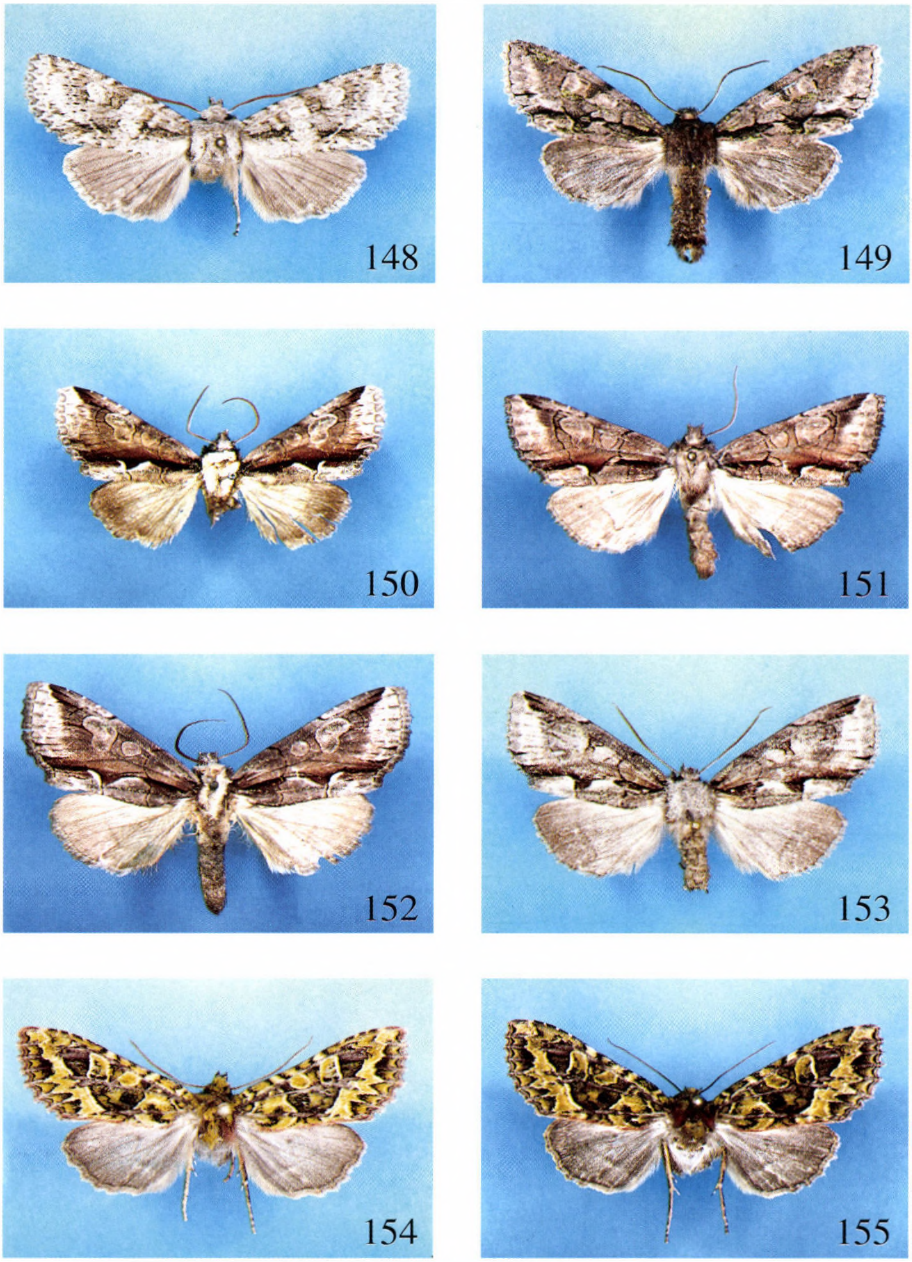
Figs 132–139. 132–133 = *Polia mortua caeca* ssp. n.: 132 = holotype, 133 = paratype, female; 134 = *Panolis exquisita* DRAUDT, 1950, lectotype, 135 = *P. variegatoides* POOLE, 1989, Taiwan; 136 = *P. exquisita*, female; 137 = *P. pinicortex* DRAUDT, 1950, lectotype; 138–139 = *P. p. exornata* ssp. n.: 138 = holotype, 139 = paratype; female



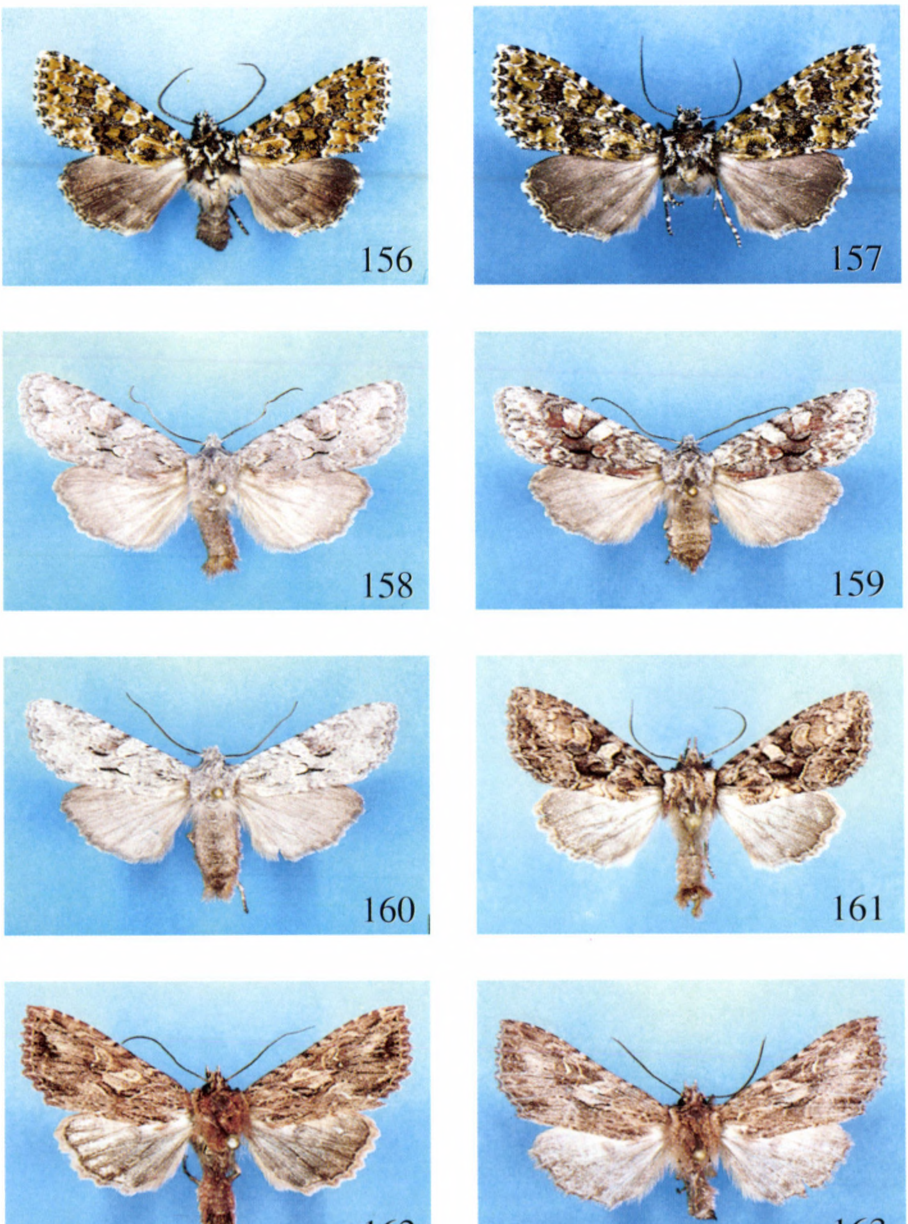
Figs 140–147. 140–141 = *Orthosia (s. l.) conspecta* WILEMAN, 1914: 140 = holotype, 141 = male, Taiwan; 142 = *O. (s. l.) poecila* (DRAUDT, 1950), lectotype; 143 = *O. (s. l.) p. fumosa* (DRAUDT, 1950), lectotype; 144–145 = *Perigrapha nigrocincta* sp. n.: 144 = holotype, 145 = paratype, female; 146 = *Cosmia poecila* sp. n., holotype, 147 = *Dryobotodes formosanus* HREBLAY et RONKAY, 1997, female



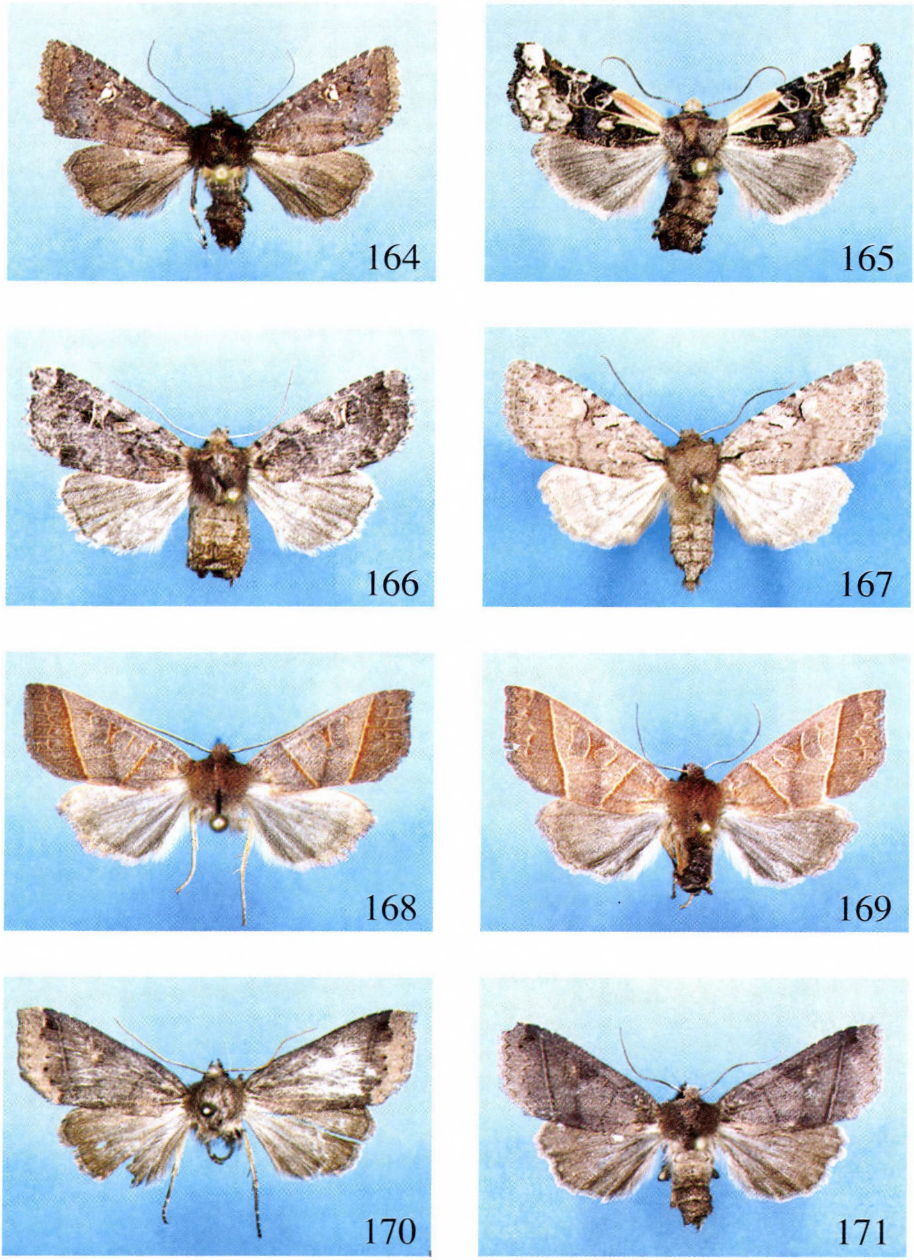
Figs 148–155. 148 = *Meganephria weixleri* sp. n., holotype; 149 = *M. crassa* KOBAYASHI et OWADA, 1996, male; 150 = *Allophyes albithorax* (DRAUDT, 1950), lectotype; 151 = *A. heliocausta* BOURSIN, 1957, paratype; 152 = *A. yuennana* sp. n., holotype; 153 = *A. miaoli* HREBLAY et KOBAYASHI, sp. n., holotype; 154–155 = *Antivaleria viridentata* sp. n.: 154 = holotype, 155 = paratype, female



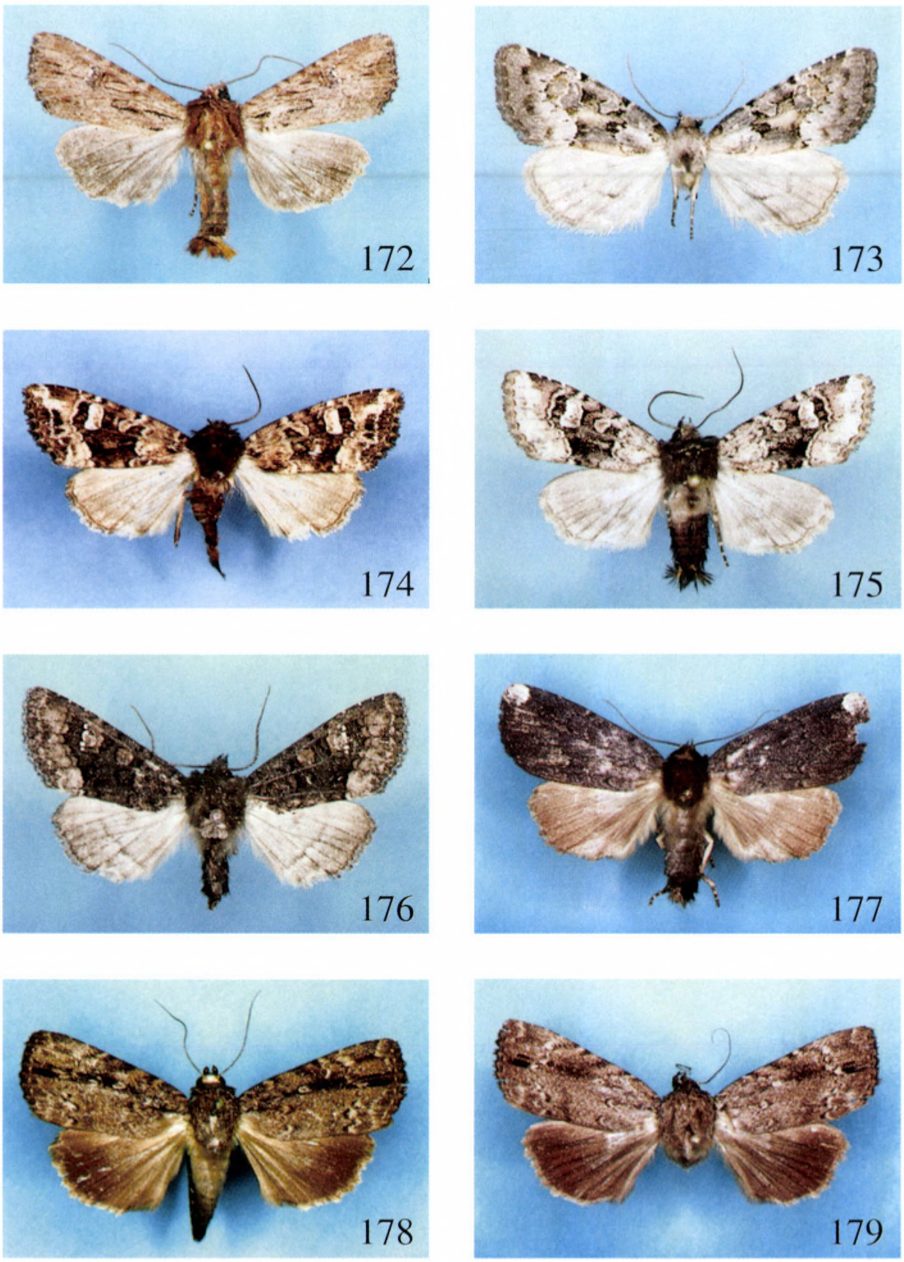
Figs 156–163. 156–157 = *Polymixis viridinigra* sp. n.: 156 = holotype, 157 = paratype, female; 158–160 = *Lithophane trimorpha* sp. n.: 158 = holotype, 159–160 = paratypes; 161 = *Nyctyciomorpha plagiogramma* (HAMPSON, 1906), Taiwan; 162–163 = *Potnyctycia cristifera* sp. n.: 162 = holotype, 163 = paratype, female



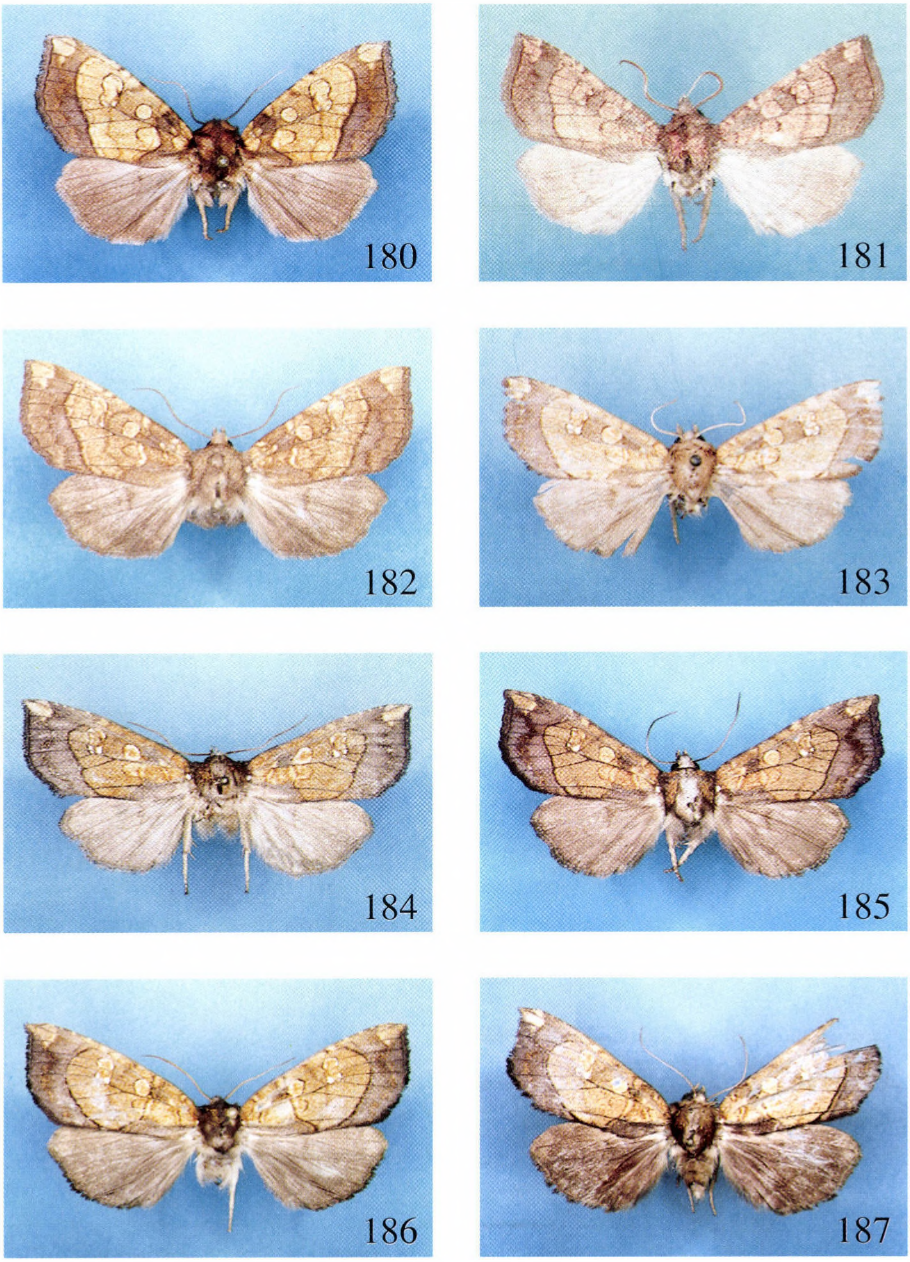
Figs 164–171. 164 = *Blepharosis theobroma* sp. n., holotype; 165 = *Teratoglaea pacifica* SUGI, 1958, Taiwan; 166 = *Himalistra soluta* sp. n., holotype; 167 = *Estagrotis tibori* HREBLAY et RONKAY, 1997, female; 168–169 = *Telorta shenhornyeni* sp. n. 168 = holotype, 169 = paratype; 170–171 = *T. atrifusa* sp. n.: 170 = holotype, 171 = paratype, female



Figs 172–179. 172 = *Apamea aquila substriata* ssp. n., holotype; 173 = *Chortodes cornutifera* sp. n., holotype; 174 = *Oroplexia euplexina* (DRAUDT, 1950), lectotype; 175 = *O. variegata* HREBLAY et RONKAY, 1997, holotype; 176 = *O. fortunata* sp. n., holotype; 177 = *Amphipyra schrenckii* ssp., Taiwan; 178 = *A. charon* DRAUDT, 1950, female, Hoengshan; 179 = *A. averna* sp. n., holotype



Figs 180–187. 180 = *Gortyna fortis* (BUTLER, 1878), Japan; 181 = *G. basalipunctata* (GRAESER, 1889), Russia, Far East; 182 = *G. flavina* sp. n., paratype, female; 183 = *G. imitans* sp. n., holotype; 184–185 = *G. plumbitincta* sp. n.: 184 = holotype, 185 = paratype, female; 186–187 = *G. plumbeata* sp. n.: 186 = holotype, 187 = paratype, female, Vietnam



from Tapaishan (China). The genitalia of this specimen are similar in type to the typical *fortis* but differ from it in almost all details (Figs 103, 104). This specimen probably represents another distinct species, but, having an unique specimen of this difficult species complex, we refrain from describing it.

Gortyna plumbitincta sp. n.
(Figs 109, 110, 118, 184, 185)

Holotype: male, Taiwan, Prov. Taitung, Hsiangyang, police station, 2320 m, 25–26.X.1996, leg. GY. FÁBIÁN & F. NEMES, slide No. HM9749 (coll. FÁBIÁN).

Paratypes: Taiwan. Prov. Taitung: 1 f, Prov. Taitung, Hsiangyang, police station, 2320 m, 2.XI.1996; 1 m, 2 km N Liyusan, 1760 m, 23.X.1996, leg. GY. FÁBIÁN & F. NEMES. Prov. Kaohsiung: 1 f, 16m km SE of Taoyüan, 1370 m, 23. X. 1995, 120°52'E, 23°17'N, leg. T. CSŐVÁRI & P. STÉGER. Prov. Nantou: 1 f, 3 km SW of Tsuifeng, 2100 m, 31. X. 1996, 121°10'E, 24°06'N, leg. T. CSŐVÁRI & CS. SZABÓKY (coll. HREBLAY); 1 f, Meimu, 2000 m, 28.X.1996, GY. FÁBIÁN & F. NEMES. Prov. Hualien: 1 m, 2 f, Kuanyuan, 1380 m, 11–12.X.1996, GY. FÁBIÁN & F. NEMES; 1 m, 1 f, Tayuling, 30 km SE of Lishan, 2650 m, 25. IX. 1992, leg. AULOMBARD & PLANTE. Prov. Taichung: 1 f, Tachen, 1890 m, 29.X.1996, leg. GY. FÁBIÁN & F. NEMES (colls Mus. Univ. Sun-Yat Sen, Kaohsiung, CSŐVÁRI, FÁBIÁN, HREBLAY, PLANTE).
Slide No. HM9745 (female).

Diagnosis: the closest relatives of *Gortyna plumbitincta* sp. n. are *G. plumbeata* sp. n. (Vietnam) and *G. imitans* sp. n. (China, Yuennan), described below, the comparison of them is given under *G. plumbeata*. *G. plumbitincta* is similar also to *G. basalipunctata* (GRAESER, 1889) (Figs 105, 106, 116, 181) but is larger in size, the postmedial line is much more arcuate, sharply defined, the marginal area is almost unicolorous, characteristically dark plumbeous grey, the apex is more acute, etc.; the genitalia of both sexes are strongly different (see Figs).

The new species differs from the allied *G. flavina* sp. n. (described above) and *G. fortis* (BUTLER, 1878) in the larger size, the whitish basal spot and the whitish markings of the reniform, the conspicuously arcuate postmedial line and the evenly plumbeous-greyish marginal field. The male genitalia of *G. plumbitincta* differ very strongly from those of the related species, e.g. by the differently shaped costal lobe, the more simple costal process, the trapezoidal shape of the clavus, the shape, size and armature of cornuti in the vesica, etc.(see Figs). The female genitalia of *G. plumbitincta* has, compared with those of *G. flavina and G. fortis*, longer ductus bursae, smaller cervix bursae and four longer signa.

The taxon *G. intermixta* SWINHOE, 1891, considered as synonymous with *G. basalipunctata* is described from the southern Himalaya. The illustration in WARREN (1913) of a specimen from the Himalayan region displays the external features typical of *G. basalipunctata*, being easily separable from *G. plumbitincta* and *G. plumbeata*. *G. joannisi* (BOURSIN, 1928), from Vietnam differs from all

newly found *Gortyna* species, moreover, *G. plumbeata* sp. n., occurring in North Vietnam, is closer in external and genital features to *G. plumbitincta* and *G. imitans*, than to *G. joannisi*.

Description: wingspan 42–47 mm, length of forewing 19–23 mm. Head and thorax dark fuscous with some bluish-grey and a few ochreous scales, collar and tegulae mixed with golden-orange, antennae filiform in both sexes. Abdomen paler, brownish grey, dorsal crest reduced to a small tuft on 2nd segment. Forewing high, broadly triangular with apex acute, outer margin concave below apex. Ground colour deep golden-orange, medial field irrorated with greyish brown, lower third of basal area and wide marginal field suffused with dark plumbeous grey and brown. Veins covered with blackish grey, apical patch golden-ochreous. Basal spot sharply defined, clear white, subbasal line short, almost straight. Antemedial line simple, oblique, slightly sinuous, medial line a pale, diffuse, dark grey stripe, postmedial double, strongly curved around cell, inner line sharp, dark brown, outer line much paler, bluish grey. Orbicular big, rounded, encircled with blackish, reniform relatively small, elliptical, marked with a fine brown outline, a big and a few smaller bright white spots. Claviform big, rounded, filled with golden-ochreous, often forming a long, light patch running from base of wing to tip of claviform. Subterminal interrupted, obsolescent, orange-ochreous, terminal line dark grey, defined by a fine ochreous outer zone; cilia plumbeous grey. Hindwing suffused with dark brownish grey, inner area somewhat lighter, veins and discal spot darker brown. Underside of wings whitish, forewing and marginal area of hindwing strongly suffused with dark brown-grey, transverse line and discal spot regularly present but diffuse on both wings.

Male genitalia (Figs 109, 110): uncus short, fine, apically pointed, tegumen low, wide, penicular lobes rather small, densely hairy. Fultura inferior pentagonal, high, vinculum wide, rounded. Valva elongated, rather narrow, costa with a sclerotized subapical region, ventral margin with a small, setose medial lobe. Cucullus rounded triangular, with apex finely pointed, ventral extension short, thick; corona present. Sacculus strong but short, clavus large, trapezoidal, covered by fine setae. Harpe reduced to its short basal bar, ampulla small, weak, costal process flattened, rather short, apically rounded. Aedeagus long, cylindrical, curved, carina with a strong, dentated ventral and a weaker, smooth dorsal bar. Vesica relatively short, broadly tubular, distally dilated, armed with a strong terminal cornutus sitting on a small diverticulum and with 3–4 fine spinules situated close to ductus ejaculatorius.

Female genitalia (Fig. 118): ovipositor strong, conical, acute, gonapophyses strong. Ostium bursae calyculate, with a strongly sclerotized caudal plate. Ductus bursae long, more or less tubular, ribbed, inner surface granulosely sclerotized. Cervix bursae small, rounded, with strong parallel wrinkles, corpus bursae elliptical-ovoid, bearing four signum-stripes.

Gortyna plumbeata sp. n.
(Figs 111, 112, 119, 186, 187)

Holotype: male, "N-Thailand, Nan Prov., Pua Doi Phu Kha, km 35, 1680 m, 9.-15.10.1993, leg. H. Schnitzler", "Museum A. Koenig, Eing. Nr. 94/400, ex. Coll.", slide No. HM10010, coll. MAK, Bonn.

Paratype: female, N Vietnam, Mai-chau, 1400 m, 25 km SE Moc-chau, 20°50'N, 104°40'E, 14–18. XI. 1994, leg. SINAEV & SIMONOV, slide No HM8944 (coll. HREBLAY).

Diagnosis: the *G. plumbitincta* line consists of three recently found species forming a compact species group. *G. plumbeata* differs externally from *G. plum-*

bitincta by its evenly curved postmedial line. The male genitalia of the two species display rather large differences, *G. plumbeata* has longer costal lobe, as high as tip of cucullus, the cucullus is rounded triangular with rather long, pointed ventral extension, the clavus is larger, with rounded projection towards fultura inferior, the aedeagus is longer, ventral plate of carina much stronger, dorsal plate reduced, the vesica is longer, narrower, the single cornutus is significantly smaller, finer, the spinulose field consisting of much larger, stronger spines situated relatively far from the sole cornutus. The female genitalia of *G. plumbeata* differ from those of *G. plumbitincta* in the longer, narrower ovipositor, smaller ostium bursae having narrower caudal plate, longer, more curved ductus bursae and larger, more distinct cervix bursae.

The third member of the species-group, *G. imitans* differs externally rather strongly from *G. plumbeata* and *G. plumbitincta*, resembling most closely *G. flavina* and *G. fortis* in the narrower marginal field closed by the less arcuate, fine postmedial line and the paler colouration of the hindwing. On the other hand, the genitalia of both sexes indicate close relationship with the two other taxa of the group. In the male genitalia, compared with the two relatives, *G. imitans* has the highest cucullus with the costal lobe situated relatively far from the tip of valva, the longest, most acute ventral extension, the largest clavus, the ventral plate of the carina is long, narrow, almost straight, covered with larger teeth, the bulbed cornutus is completely missing but the cornuti field is significantly longer, stronger. In the female genitalia *G. imitans* has the longest ductus bursae and the largest cervix bursae, the medial lobe of the ductus is rather small but strong, situated closer to cervix than in the other two species.

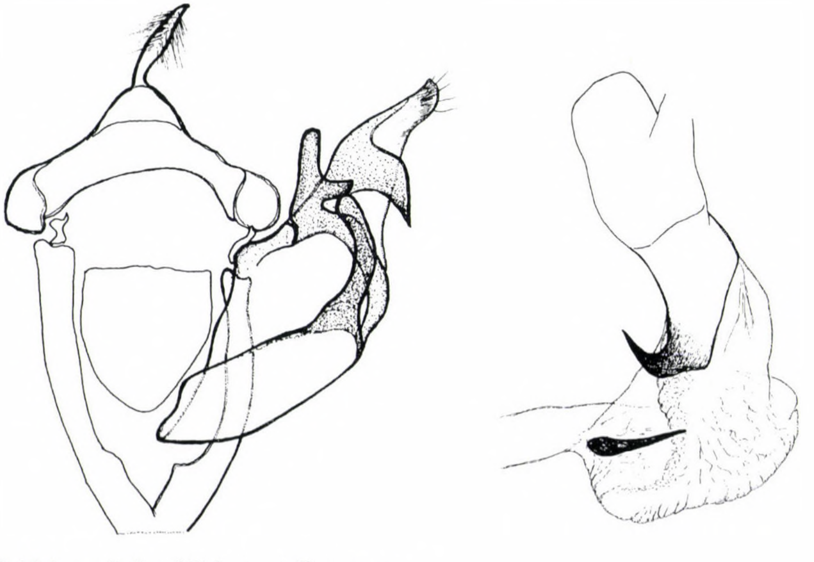


Fig. 188. Male genitalia of *Telorta atrifusa* sp. n.

Description: wingspan 43–44 mm, length of forewing 22 mm. Head and thorax dark fuscous with some grey and a few ochreous scales, collar and tegulae mixed with golden-orange, antennae filiform. Abdomen paler, brownish grey. Forewing high, broadly triangular with acute apex, outer margin concave below apex. Ground colour deep golden-orange, medial field irrorated with greyish brown, lower third of basal area and wide marginal field suffused with dark plumbeous grey and brown. Veins covered with dark grey, apical patch golden-ochreous. Basal spot sharply defined, whitish-ochreous. Subbasal and antemedial line double, brown, filled with ochreous. Postmedial line narrow, more or less double, filled with some ochreous coloration, upper half evenly curved. Subterminal diffuse, marginal area and cilia plumbeous grey. Orbicular big, rounded, encircled partly with blackish, reniform elliptical, marked with a fine, incomplete, brown outline and a big and a few smaller, bright whitish-ochreous spots; claviform indistinct. Hindwing uniformly dark brownish grey, inner area somewhat lighter, veins and discal spot darker brown. Underside of the forewing much darker than the hindwing, transverse lines and discal spots finely marked on both wings; marginal area and cilia darker.

Male genitalia (Figs 111, 112): similar in type to those of *G. plumbitincta*, the differences are mentioned in the diagnosis.

Female genitalia (Fig. 119): ovipositor rather long, strong, acute, gonapophyses strong. Ostium bursae calyculate, membranous, with a sclerotized caudal plate. Ductus bursae relatively long, tubular, curved, with sclerotized ribs, inner surface granulosely sclerotized. Cervix bursae small, rounded, with strong wrinkles, corpus bursae elliptical-ovoid, bearing four signa.

Gortyna imitans sp. n.
(Figs 113, 114, 120, 183)

Holotype: male, "Li-kiang (China), Provinz Nord-Yuennan 6. 9. 1935, H. Höne", Slide No. HM10003 (MAK, Bonn).

Paratypes: 1 m, 1 f, Li-kiang (China), Provinz Nord-Yuennan, 21. 9. 1934, 23. 9. 1935, H. HÖNE (MAK, Bonn).
Slide Nos BOURSIN Hö 412 (male), HM10004 (female).

Diagnosis: the new species is presumably an allopatric sibling of *G. plumbitincta* and *G. plumbeata*. *G. imitans* differs externally from both relatives in the much paler, *fortis-* or *flavina*-like colouration, the marginal area is narrower, without the strong plumbeous suffusion, the postmedial is much less curved around cell, the hindwing is paler, etc. The comparison of the genitalia of the three related taxa is given in the diagnosis of *G. plumbeata*.

Description: wingspan 39–43 mm, length of forewing 18–21 mm. Head and thorax brownish, collar and tegulae mixed with ochreous-orange, antennae filiform in both sexes. Forewing high, broadly triangular with apex acute, outer margin concave below apex. Ground colour deep ochreous with some orange and golden gloss, irrorated with orange-brown, some parts of basal area and marginal field suffused with darker brown and greyish. Veins covered with brownish grey, apical patch golden-ochreous. Basal spot whitish or pale ochreous, ante- and postmedial lines fine, more or less double, former slightly, sinuous, not or only slightly angled inwards at claviform spot than outwards to inner margin. Medial line absent or obsolete, sinuous, brownish stripe, postmedial line less sinuous, upper part arcuate, lower part oblique, more or less straight. Orbicular big, rounded, reniform elliptical, both encircled with dark brown, reniform marked also with some white(ish) spots; claviform a small, rounded, brown arch. Subterminal more or less continuous,

rather diffuse, ochreous, defined by a darker greyish inner shadow. Terminal line dark brown, cilia darker, grey-brown. Hindwing ochreous, suffused with dark brownish grey, inner area only slightly lighter, veins and discal spot somewhat darker. Underside of wings ochreous, variably strongly irrorated with darker brown-grey, discal spots and transverse lines present but diffuse on both wings.

Male genitalia (Figs 113, 114): similar in type to those of *G. plumbitincta* and *G. plumbeata* but fultura inferior higher, narrower, cucullus higher with longer, narrower ventral extension, clavus larger, broader, aedeagus shorter, thicker, less arcuate, ventral plate of carina much more elongated, almost straight, covered sparsely with large teeth, vesica broader, recurved, without medial cornutus but with a long terminal cornuti field consisting of long spines.

Female genitalia (Fig. 120): ovipositor strong, acute, gonapophyses strong. Ostium bursae short, more or less calyculate with sclerotized posterior half. Ductus bursae rather long, curved, proximally tapering, with strong ribs and lateral sclerotization, lateral appendage small, rounded, situated close to base of cervix bursae. Cervix bursae large, apically rounded, sclerotized and ribbed, corpus bursae elliptical, with four fine, long signa.

Amphipyra averna sp. n.
(Figs 122, 179)

Holotype: female, Taiwan, Prov. Taoyuan, 16 km E of Fuhsing, 870 m, 27. X. 1996, 121°24'E, 24°50'N, leg. T. Csővári & Cs. Szabóky, slide No. HM9739 female (coll. Hreblay).

Diagnosis: *Amphipyra averna* sp. n. is the Taiwanese sister species of *A. charon* Draudt, 1950 (Figs 123, 178), and differs from it in the somewhat narrower forewing, the paler, more indistinct spot of the reniform, and paler cilia. The female genitalia differ in the shorter and broader ductus bursae. The also closely related *A. monochroma* Yoshimoto, 1994 (Fig. 122) has evenly darker ground colour, and similar dark cilia of the hindwing.

Description: wingspan 49 mm, length of forewing 23 mm. Palpi dark chocolate-brown mixed some whitish scales. Frons, collar, tegulae, thorax and the forewing lighter, mixture of brown and ochreous scales. Antennae of male filiform. Antemedian and postmedian lines wide, double, sinuosely, filled with lighter coloration. Submarginal line indistinct, marginal line somewhat darker, cilia in same colour. Orbicular small, pale with a dark spot in the middle, outer part of cell with a large, diffuse, indistinct dark shadow. In the marginal field at the veins Cu 1–2 two blackish stripes. Hindwing somewhat darker, basal area little paler, without pattern, cilia ochreous. Underside of forewing paler, with indistinct postmedian line, discal spot and a dark marginal stripe present on hindwing.

Female genitalia: Ovipositor hardly sclerotized, gonapophyses long. Ostium wide, funnel-like, a small, rounded, well sclerotized plate with tiny crest in the middle. Ductus bursae narrow proximally somewhat enlarged, hardly sclerotized. Corpus bursae spacious, membranous sac, without signa.

* * *

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THE IMPACT OF GRAZING AND ROAD USE ON HATCHING SUCCESS OF LAPWINGS (VANELLUS VANELLUS)

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Hatching success of Lapwings was studied in a Hungarian alkaline grassland ("puszta") between 1992 and 1994. We estimated that 85% of nests fail during egg-laying and incubation. Two potential reasons for the high nest loss were investigated: trampling due to grazing livestock and disturbance due to the use of unmade roads. Hatching success was not significantly different between grazed (14%) and ungrazed grasslands (16%); thus we conclude that grazing did not influence hatching success. Similarly, hatching success was not significantly different between nests close to unmade roads (14%) and distant nests (17%). Behavioural observations supported both results, since the proportion of time when the nests was incubated by the parents was not different either between grazed and ungrazed, or between close and distant nests. Our results suggest that the influence of nest-predators (mammals and birds) are more significant on hatching success than trampling by sheep or disturbance due to road use.

Key words: conservation biology, reproductive success, grazing, road use, shorebirds, Lapwing, *Vanellus vanellus*

INTRODUCTION

Human activities such as land use and disturbance may adversely affect the breeding of several avian species. Grazing livestock may influence breeding by altering the structure of the habitat, changing the distribution of the birds' food and trampling the nests of ground-nesting birds (HUDSON *et al.* 1994, FLEISCHNER 1994). Grazing may reduce the population densities of birds and influence the composition of avian communities (FLEISCHNER 1994). Similarly, the use of roads may increase adult mortality and the rate of emigration, and it may reduce the densities of bird populations (van der ZANDE *et al.* 1980, REIJNEN & FOPPEN 1991, 1994).

These effects, however, are not overwhelming. A number of studies failed to find evidence for the negative impact of grazing and road use on reproductive

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success of ground nesting birds. For example, the hatching success of the Upland Sandpiper *(Bartramia longicauda)*, was unaffected by the presence of grazing animals, and the density of several breeding shorebirds and waterfowl increased in some grazed areas (ULFVENS 1991, BOWEN & KRUSE 1993). Birds easily habituate to moderate traffic and their population density may be unaffected by roads (CARROLL & CRAWFORD 1991, WARNER 1992).

We investigated the influence of grazing and road use in a ground-nesting shorebird, the Lapwing *(Vanellus vanellus)*. The Lapwing is one of the most common breeding shorebirds in Europe, but nevertheless it appears to be declining over much of its range (HÖTKER 1991). One explanation for the decline is the low breeding success in agricultural lands such as meadows, grasslands and arable fields (BAINES 1990, SHRUBB 1990, HUDSON *et al.* 1994, PEACH *et al.* 1994). We hypothesised that breeding success of Lapwings may be adversely affected by the presence of grazing livestock and by the disturbance associated with the use of unmade roads in a Hungarian alkaline grassland ("puszta"). As several strictly protected birds breed in the puszta e.g. Collared Pratincole *(Glareola pratincola)*, Kentish Plover *(Charadrius alexandrinus)*, Stone-Curlew *(Burhinus oedicnemus)* and Short-toad Lark *(Calandrella brachydactyla)*, monitoring the hatching success of Lapwings may indicate adverse effects on the hatching success of these ground-nesting birds too.

METHODS

We investigated the Lapwings in Miklapuszta (46°40'N, 19°10'E), Central Hungary, between 1992 and 1994. The study site was an alkaline grassland of about 2000 ha where 200–300 Lapwings bred each year (LIKER & SZÉKELY 1997*a, b*). We investigated an area of approximately 700 ha every year. The vegetation consisted of halophytic plants such as *Festuca pseudovina*, *Puccinellia limosa*, *Artemisia maritima*, *Lepidium cartilagineum* and *Camphorosma annua* (description of the study site is given by SZÉKELY *et al.* 1994, LIKER & SZÉKELY 1997*b*).

Fieldwork was carried out between the second week of March (1994), or the first week of April (1992–1993), and the end of June (all three years). Once a nest was found we checked it every 2 or 4 days. Successful nests, i.e. those that hatched at least one chick, were identified by the presence of chick(s) in the nest or by minute eggshell fragments in the nest material. Incubation behaviour was studied over the breeding season at nests in which either one or both parents were individually identified (LIKER & SZÉKELY 1997*a, b*). The observations were collected from a hide at 200–300 m from the nest between 0600 and 2100 h (Central European Time). We recorded whether the nest was incubated by either male or

female parent every minute for 60 to 120 minutes. Each nest was observed on 1–5 days.

Nest failures were identified by the remnants of eggs and the tracks around the nests. Trampling was identified by the flattened eggs in the nest scrape and sheep tracks around the nest. Predation was identified by the broken eggshell remnants around the nest or by the disappearance of the eggs from the nest. Abandoned clutches were identified by feeling cool on at least two consecutive visits and the eggs of these clutches were stuck into the nest material. The mid-date between the detection of failure and the last visit when the clutch was still incubated was used to estimate the date of nest failure.

A variable portion of the study site was used for extensive sheep-farming in each year since about 600, 400 and 300 ha was grazed in 1992, 1993 and 1994, respectively. Grasslands referred to as grazed fields were grazed by sheep in a given breeding season, whereas no sheep were observed in ungrazed fields. Location of grazed and ungrazed fields varied between years, i.e. some fields were grazed in one year but not in the other. The density of sheep was about 3.0–3.5 sheep ha^{-1} in each year.

The distance of Lapwing nests to the nearest road was measured either in the field or estimated on a map of 1:10 000 scale. Nests were divided into close nests (≤ 150 m from the nearest unmade road) and distant nests (> 150 m from the nearest unmade road). Close nests were 77.6 ± 3.2 (SE) m from the closest road (n = 183 nests), and distant nests were 312.8 ± 10.7 m from the closest unmade road (n = 135 nests). The unmade roads were on the same level as the surrounding grasslands, they were neither fenced nor hedged, and they directly crossed the breeding sites of the birds. The roads were used mainly by local farmers. Intensity of road use varied between roads and over the breeding season although most roads were used a few times in a day. The set of active roads varied between years i.e. some roads were used in one year but not in the other. Only those roads which were used in a given year were included in the analyses, thus sample sizes may be different between the analyses of grazing and road use.

Each nest was considered as one data point; if several observations were available for a nest then the mean of the observations was used. Data from all years were pooled, although our conclusions remain unchanged when each year was analysed separately (results not shown). The breeding population of Lapwing was large, thus the chance was small to include an individual more than once in the analyses (LIKER & SZÉKELY 1997*b*). We used parametric tests, or if the assumptions of parametric tests were violated then non-parametric tests were applied. Daily probability of nest predation, trampling, abandonment and nest survival were estimated by the method of MAYFIELD (1975). Since egg-laying was completed in 5 days and the incubation lasted for 26 days (A. LIKER & G. NOSZALY, unpublished data), nests were exposed to predators for about 31 days.

Table 1. Hatching success of Lapwing nests in Hungary between 1992 and 1994

Year	Failed due to			Hatched (%)	No. of nests
	Predation (%)	Trampling (%)	Abandonment (%)		
1992	53.5	7.0	3.5	36.0	86
1993	61.4	3.4	1.1	34.1	88
1994	65.1	4.0	2.7	28.2	149
All years	61.0	4.6	2.5	31.9	323

Standard errors of daily nest survival and tests of significance were calculated as recommended by HENSLER & NICHOLS (1981). Statistical analyses were carried out by the SPSS programme package for the Macintosh. Mean ± SE values and two-tailed probabilities are given.

RESULTS

Hatching success and causes of nest failure

Altogether 68% of the nests failed and the single most common reason for nest loss was predation (Table 1). Only 32% of the nests hatched at least one chick (Table 1). Since many nests must have failed before we found them, we also estimated the daily probability of nest survival by the Mayfield method (Table 2). These estimates suggested that only 15% of nests were expected to survive for 31 days of exposure (Table 2).

The impact of grazing

The survival of the nests was not different between grazed and ungrazed grasslands, as 13.9% and 15.7% of nests were expected to survive for 31 days in grazed fields and ungrazed fields, respectively (Table 3). Although daily prob-

Table 2. Hatching success of Lapwing nests. Daily probabilities of nest survival (P ± SE) were calculated as given by MAYFIELD (1975) and HENSLER & NICHOLS (1981). Hatching success was calculated as P^{31}, where 31 days of total exposure corresponds to 5 days of egg-laying and 26 days of incubation

Year	No. of nests		Nest	P ± SE	Hatching success
	found	lost	days		
1992	86	55	949	0.9420 ± 0.0076	0.157
1993	88	58	926	0.9374 ± 0.0080	0.135
1994	149	107	1825	0.9414 ± 0.0055	0.154
All years	323	220	3700	0.9405 ± 0.0039	0.150

Table 3. Daily probabilities of nest survival in grazed and ungrazed fields (P ± SE, see MAYFIELD 1975, HENSLER & NICHOLS 1981). Grazed and ungrazed nests were observed for 1852 and 1605 days in total, respectively. the z and p values were calculated as given by HENSLER & NICHOLS (1981)

Habitat	Daily probability of				No. of nests
	Predation	Trampling	Abandonment	Survival	
Grazed	0.0519 ± 0.0052	0.0081 ± 0.0021	0.0016 ± 0.0009	0.9384 ± 0.0056	168
Ungrazed	0.0548 ± 0.0057	0.0 ± 0.0	0.0031 ± 0.0014	0.9421 ± 0.0058	131
z	0.390	3.889	0.892	0.447	
p	> 0.6	< 0.0001	> 0.3	> 0.6	

ability of trampling was higher in grazed than in ungrazed fields (Table 3), the influence of trampling was negligible since only fifteen out of 168 nests (8.9%) were trampled by sheep in the grazed fields. We found no evidence that grazing influenced daily probabilities of nest predation and abandonment (Table 3). Finally, grazing did not influence incubation behaviour, as nests were incubated for 79.1 ± 2.1% (n = 63 nests) and for 78.6 ± 3.1% (n = 33 nests) of the time in grazed and ungrazed fields, respectively (Mann-Whitney U test, z = 0.077, p > 0.9).

The impact of distance to roads

We found no difference in daily probabilities of nest survival between close and distant nests (Table 4). In particular, 13.7% and 16.9% of close and distant nests were expected to survive for 31 days, respectively (Table 4). Furthermore, the proportion of time when the nest was incubated was not different between close nests (76.7 ± 2.4%, n = 55 nests) and distant ones (81.1 ± 2.2%, n = 49 nests; Mann-Whitney U test, z = 1.127, p > 0.2).

Table 4. Daily probabilities of nest survival in relation to the distance from roads (P ± SE, see MAYFIELD 1975, HENSLER & NICHOLS 1981). Close and distant nests were ≤ 150 m and > 150 m from the nearest unmade road, and they were observed for 2146 and 1528 days in total, respectively. z and p were calculated as given by HENSLER & NICHOLS (1981)

Proximity to roads	Daily probability of				No. of nests
	Predation	Trampling	Abandonment	Survival	
Close	0.0550 ± 0.0049	0.0047 ± 0.0015	0.0023 ± 0.0010	0.9380 ± 0.0052	183
Distant	0.0503 ± 0.0056	0.0033 ± 0.0015	0.0020 ± 0.0011	0.9444 ± 0.0058	135
z	0.616	0.669	0.238	0.810	
p	> 0.5	> 0.5	> 0.8	> 0.4	

DISCUSSION

We estimated that about 85% of the Lapwing nests failed before hatching. This value seems to be higher than those found in other populations of Lapwing (HUDSON *et al.* 1994). In our population the main cause of the nest loss was predation, probably by birds (e.g. corvids and harriers) and mammals' e. g. foxes, mustelids and straying dogs (A. LIKER and T. SZÉKELY, unpublished data). Sheep grazing did not influence the hatching success of Lapwings. The low incidence of trampling may be due to the low density of sheep. Other studies revealed variable impacts of grazing on hatching success of shorebirds. For example, 2–9% and 23% of Lapwing nests were trampled by livestock in British grasslands and Dutch meadows, respectively (BEINTEMA & MÜSKENS 1987, BAINES 1990, SHRUBB 1990). Also, 2% of Upland Sandpiper nests were trampled by cattle in the US (BOWEN & KRUSE 1993). The difference between these trampling rates may be due to the density and species of livestock. A positive correlation was found between the density of livestock and the frequency of nest trampling by BEINTEMA & MÜSKENS (1987) and SHRUBB (1990). The species of grazing animal may be also important as cattle tend to increase the frequency of nest abandonment in Lapwings, while the influence of sheep grazing appears to be minor (BEINTEMA & MÜSKENS 1987, SHRUBB 1990). The difference between livestock may be related to their grazing habits as cattle may keep the Lapwing parents away from their nest for a longer period of time than sheep thus eventually forcing the parents to abandon their nest.

On the other hand, grazing may have a positive influence on ground-nesting birds. First, grazing animals may remove a significant amount of grass thus they maintain short vegetation. This may be important for several ground-nesting birds. For example, Kentish Plovers often breed on such alkaline grasslands which are frequently grazed by sheep (SZÉKELY *et al.* 1993). If grazing stops then the vegetation quickly overgrows and Kentish Plovers disappear. Secondly, grazing livestock may attract insectivorous birds. In Hungary extensive cattle herds are often followed by foraging flocks of Collared Pratincoles, and Kentish Plovers frequently feed on such pastures which are grazed by sheep (SZÉKELY *et al.* 1993). STERBETZ (1992) showed that as the number of grazing livestock declined in a Hungarian grassland, so did the number of breeding Kentish Plovers. Although these observational studies are important to direct the attention of conservationists to the various costs and benefits of grazing for ground nesting birds, the exact nature of the relations warrants further studies. In particular, field experiments are required to demonstrate how the different species of livestock (e.g. cattle, sheep and horse) influence habitat structure, prey abundance and reproductive success of ground-nesting birds in the puszta.

Road use did not influence the reproductive success of Lapwings in our study area, although these roads were infrequently used. Recent studies showed that several ground-nesting birds are also unaffected by road traffic. Grey Partridge *Perdix perdix* select nest sites irrespective of the distance to motorways with heavy traffic (CARROLL & CRAWFORD 1991). Vehicular traffic (0–16 cars per 15 minutes) also has a negligible effect on the breeding behaviour and productivity of Burrowing Owls *Speotyto cunicularia* which breed near to these roads (PLUMPTON & LUTZ 1993).

However, many of these results are observational and thus may be confounded by the non-random distribution of breeding birds. For example, if the 'best' Lapwings, i.e. the ones which are able to protect their nest most successfully, choose to settle on grazed grasslands, then the effect of trampling may have been underestimated. Similarly, if 'poor' breeders avoid to lay their eggs close to roads the unaffected reproduction in the vicinity of roads may not mean that the road use does not influence Lapwing's breeding in this habitat. To demonstrate unequivocally the impact of grazing and road use on the reproductive success of birds one has to carry out experiments in the natural habitat of these birds. One avenue is to use artificial nests (PATON 1994) and investigate the mortality of the artificial nests in relation to grazing and road use. Another possibility is to manipulate experimentally the grazing pressure and road use, and investigate the response of breeding birds to these treatments. Good habitat management practice requires such experiments. Certainly, successful execution of such experiments will be a challenging task for conservation-minded field ornithologists.

* * *

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BRACONIDAE (HYMENOPTERA) FROM KOREA, XIX.*

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Descriptions of seven new species of the genus *Bracon* FABRICIUS (subfamily Braconinae) are presented as follows: *B. (Foveobracon) belokobylskiji* sp. n., *B. (B.) cisellatus* sp. n., *B. (Glabrobracon) koreanus* sp. n., *B. (Foveobracon) nodulosus* sp. n., *B. (Glabrobracon) patens* sp. n., *B. (Foveobracon) pinguis* sp. n. and *B. (Glabrobracon) trilateris* sp. n. *B. (Orthobracon) cinctus* (WALKER, 1874) comb. n. is transferred from the genus *Hecabolus* Curtis, redescribed and differentiated from its nearest ally *B. (Orthobracon) epitriptus* MARSHALL, 1885. *Bracon cinctus* (Provancher) is renamed as *B. provancheri* nom. n. The type specimens of the new species are deposited in the Hungarian Natural History Museum, Budapest. With 57 original figures.

Key words: Hymenoptera, Braconidae, new species, nearest allies, Korea

Subfamily BRACONINAE

Bracon (Foveobracon) belokobylskiji sp. n. ♀ (Figs 1–4)

Material examined. – Holotype ♀ + 1 ♀ paratype: Korea, Mt. Pektusan, environs Samziyan Hotel, wood, netting in grasses, 18–20 July 1977, leg. Dely-Draskovits (loc. No. 374). – Holotype and one paratype deposited in the Hungarian Natural History Museum (Department of Zoology), Budapest, Hym. Typ. Nos 7741 (holotype) and 7742 (paratype).

Etymology. – The new species is dedicated to Dr. Sergej Belokobylskij (Zoological Institute, St. Petersburg), productive explorer of the braconid fauna of the Far-Eastern Maritime Territory of Russia, adjacent to the Korean Peninsula.

Description of the holotype ♀. – Body 2.6 mm long. Head in dorsal view (Fig. 1) 1.87 times as broad as long, eye almost twice as long as temple, latter moderately receded, occiput weakly excavated. Ocelli small, elliptic, OOL** nearly twice as long as POL (Fig. 1, see arrows). Eye in lateral view 1.4 times as high as wide and one-third wider than temple, temple ventrally somewhat broadening (Fig. 2). Malar space one-third shorter than basal width of mandible, circular opening 1.5 times wider than shortest distance between eye and oral oppening. Head polished. Face laterally

* Zoological collectings by the Hungarian Natural History Museum in Korea, No. 134. – The present study was supported by the Hungarian Science Research Fund (OTKA, grant no. 17467).

** Abbreviations applied in the text: OD = diameter of an ocellus, OOL = shortest distance between hind ocellus and compound eye, POL = shortest distance between hind two ocelli; *cu1* = first section of cubital vein, *cuqu1*, *cuqu2* = first and second transverse cubital vein, *n. bas.2* = second section of basal vein, *n. rec.* recurrent vein, *r1*, *r3* and *r3* = first, second and third section of radial vein, *B* = first brachial cell, *CU2* = second cubital cell, *D1* = first discal cell.

faintly uneven. – Antenna about as long as body and with 26 antennomeres. Flagellum attenuating distally, first flagellomere three times and penultimate flagellomere 2.5 times as long as broad.

Mesosoma in lateral view 1.42 times as long as high. Notaulix faintly distinct. Mesosoma polished. – Hind femur 3.5 times as long as broad medially. Hind tibia a bit longer than hind tarsus; hind basitarsus as long as tarsomeres 2–4.

Fore wing slightly longer than body. Pterostigma 3.2 times as long as wide, issuing radial vein somewhat proximally from its middle; *r1* somewhat shorter than width of pterostigma, *r2* 2.6 times as long as *r1* and 1.3 times as long as *cuqu1*, *r3* 1.6 times as long as *r2* and reaching tip of wing. *D1* of fore wing somewhat high, i.e. *d* somewhat longer than *n. bas.2*, *n. rec.* and *n. bas.2* parallel (Fig. 3).

Metasoma somewhat shorter than head + mesosoma combined. First tergite (Fig. 4) quadratic in form, just a bit longer than broad behind, lateral margin of scutum with relatively strong crenulation, scutum polished and postero-medially with a weak and shallow foveola. Second tergite one-sixth longer than third tergite, its antero-median field relatively broad and around it less extended rugulose (Fig. 4), otherwise together with further tergites polished. Suture between tergites 2–3 moderately bisinuate and finely crenulate. Ovipositor sheath as long as hind tarsomeres 1–2.

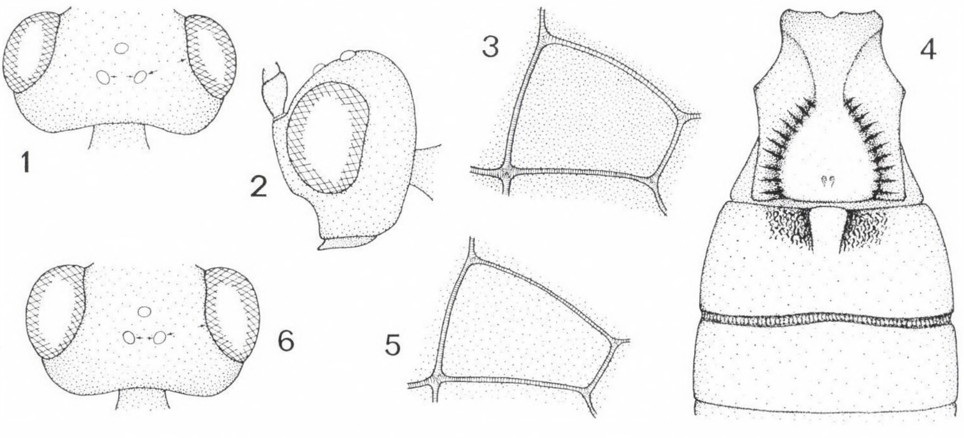
Ground colour of body black. Flagellum greyish brownish. Brownish yellow: scape, palpi, face, cheek, lower half of temple, legs, tegula and tergites 2–7 laterally. Yellowish brown (or dark brownish yellow): line of notaulices, propleuron, upper half of mesopleuron and lower half of metanotum. Vertex laterally with rusty tint. Wings brownish fumous, pterostigma and veins brownish.

Description of the female paratype (1 ♀). – Similar to the holotype. Body 2.5 mm long. Antenna with 24 antennomeres. Palpi and legs rather yellowish.

Male and host unknown.

Distribution: Korea.

Within the subgenus *Foveobracon* TOBIAS the new species, *Bracon (Foveobracon) belokobylskiji* sp. n., is nearest to *B. (F.) plugarui* TOBIAS, for their distinction, see key couplets 9 (10)–10 (9) p. 108. Disregarding the subgeneric feature (foveolae of first and second tergites), the new species resembles *B. (B.) immutator* NEES, 1834 (Palaearctic Region), but the two species are clearly distinguished by the following features:



Figs 1–6. *Bracon belokobylskiji* sp. n.: 1 = head in dorsal view, 2 = head in lateral view, 3 = first discal cell or *D1*, 4 = tergites 1–3. 5 = *B. immutator* NEES: first discal cell or *D1*. 6 = *B. cisellatus* sp. n.: head in dorsal view

1 (2) Second and third tergite equal in length. Ovipositor sheath as long as hind tarsus. *D1* of fore wing less high, i.e. *d* about one-fourth longer than *n. bas.2*, *n. rec.* and *n. bas.2* not parallel (Fig. 5). Antenna with (26–)27–31 antennomeres. Hind femur 3.7–3.8 times as long as broad. Head and mesosoma black, tegula and legs yellow, coxae 2–3 black. ♀♂: 3–4 mm
B. (B.) immutator NEES

2 (1) Second tergite one-sixth longer than third tergite. Ovipositor sheath as long as hind tarsomeres 1–2. *D1* of fore wing somewhat high, i.e. *d* somewhat longer than *n. bas.2*, *n. rec.* and *n. bas.2* parallel (Fig. 3). Antenna with 24–26 antennomeres. Hind femur 3.4–3.5 times as long as broad. Head and mesosoma black with much brownish yellow to dark brownish yellow pattern, tegula and legs brownish yellow, coxae also brownish yellow. ♀: 2.5–2.6 mm
B. (F.) belokobylskiji sp. n.

Bracon (Orthobracon) cinctus (WALKER) **comb. n.**
(Figs 7–16, 28)

Hecabolus cinctus WALKER, 1874: Cristula entomologica 1: 308 ♂, type locality: Japan (particular locality not given), lectotype ♂ in The Natural History Museum, London (syntype series 1 ♂), examined. – SHENEFELT 1976: 1356 (literature up to 1937). TOBIAS 1986: 31 (indication of its correct generic place in *Bracon*).

Designation of the lectotype ♂ of *Hecabolus cinctus* WALKER. – First rounded label with red frame: "Type". Second label: "B.M. Type Hym." [printed] "3.c.217." [handwriting]. Third label, printed: "Japan. Coll. F. WALKER. 1913–71". Fourth label, handwriting: "242". Fifth label with WALKER's(?) handwriting: "Hecabolus? cinctus". Sixth label is with M. Fischer's taxonomic remarks made in 1980, seventh label is my lectotype card and eighth label is with the correct taxonomic name given by me.

Redescription of the lectotype ♂ of *Bracon cinctus* (WALKER). – Body elongated and 5.1 mm long. Head in dorsal view (Fig. 7) transverse, 1.76 times as broad as long, eye 1.6 times as long as temple, latter strongly rounded, occiput excavated. Ocelli small and somewhat elliptic, POL:OD:OOL as 7:5:11. Eye in lateral view 1.4 times as high as wide and 1.9 times wider than temple (Fig. 8, see arrows). Malar space somewhat shorter than basal width of mandible. Horizontal width of circular opening 1.4 times as long as shortest distance between opening and compound eye. Head polished, face laterally uneven. – Antenna somewhat longer than body and with 41 antennomeres. Flagellum filiform and attenuating so that first flagellomere twice and penultimate flagellomere 2.75 times as long as broad.

Mesosoma twice as long as high. Mesonotum, scutellum, propodeum smooth and shiny. Hind femur (Fig. 9) 3.3 times as long as broad medially. Hind tibia as long as hind tarsus, hind basitarsus slightly longer than hind tarsomeres 2–4 combined.

Fore wing about as long as body. Pterostigma (Fig. 10) 3.5 times as long as wide, issuing radial vein proximally from its middle, *r1* as long as width of pterostigma, *r2* twice as long as *r1* and somewhat longer than *cuqu1*, *r3* almost straight and reaching tip of wing.

Metasoma somewhat longer than head + mesosoma combined. First tergite (Fig. 11) 1.42 times as long as broad behind, beyond pair of spiracles parallel-sided. Second tergite less transverse, 1.66 times as wide behind as long medially; suture between tergites 2–3 bisinuate and crenu-

late; third tergite transverse, 2.3 times as wide behind as long medially. First tergite with rugae laterally, margin of scutum with crenuliform rugae, second tergite longitudinally rugulose, third and further tergites smooth and shiny.

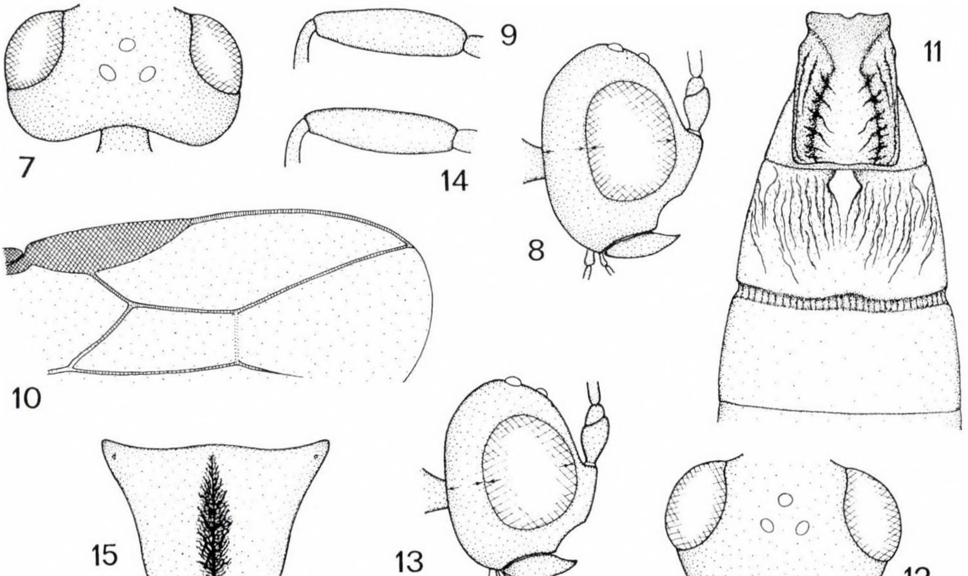
Ground colour of body black. Mandible and circular opening brownish yellow, palpi pale yellow. Scape and pedicel dark rusty brown, flagellum black. Tegula yellow. Legs yellow, hind coxa basally brown. Latero-tergites pale yellow, sternites brownish. Wings faintly fumous, pterostigma brown, veins opaque brown.

Material examined (1 ♀ and 6 ♂♂). – 1 ♀: No. 940, 1 ♂: No. 976, 1 ♂: No. 986, 1 ♂: 992, 1 ♂: No. 999, 1 ♂: 1000; 1 ♂ (in Coll. Deok Seo Ku, Suewon, Republic of Korea): Korea, Jeon Nam wangyang, Okryong Dongkok, Mt. Paikun, 14 May 1994, taken with mercury vapour lamp, leg. D. S. Ku.

Description of the female of *B. cinctus*, ♀ new. – Similar to the male. Body 5.1 mm long. Head in dorsal view (Fig. 12) 1.7 times as broad as long, eye 2.1 times as long as temple, latter receded. Ocelli small and somewhat elliptic, POL:OD:OOL as 5:5:13. Eye in lateral view 1.3 times as high as wide, 2.4 times wider than temple (Fig. 13, see arrows). Malar space as long as basal width of mandible. Head polished. – Antenna about as long as body and with 36 antennomeres. Flagellum indistinctly attenuating so that first flagellomere 2.2 and penultimate flagellomere 2.3 times as long as broad.

Mesosoma in lateral view less elongate, 1.6 times as long as high. Propodeum smooth and shiny, medio-posteriorly with oblique rugulae. Hind femur 3.6 times as long as broad (Fig. 14).

Pterostigma 3.6 times as long as wide, *r1* somewhat longer than width of pterostigma, *r2* just more than twice as long as *r1*.



Figs 7–15. *Bracon cinctus* (WALKER): 7–11 male lectotype: 7 = head in dorsal view, 8 = head in lateral view, 9 = hind femur, 10 = distal part of right fore wing, 11 = tergites 1–3; 12 = head of female in dorsal view, 13 = head of female in lateral view, 14 = hind femur of female, 15 = propodeum of male

First tergite (Fig. 16) as long as broad behind and evenly broadening posteriorly, pair of spiracles before middle of tergite, hind width 1.7 times basal width. Second tergite twice as wide behind as long medially, second tergite 1.15 times as long as third tergite. First tergite rugose with striate elements, scutum along its lateral margin with crenuliform rugae; second tergite longitudinally rugulo-striate, third tergite weakly longitudinally rugulose-striate, medially smooth (Fig. 16). Further tergites smooth and shiny. Ovipositor sheath almost as long as hind tibia + tarsus combined.

Colour of body similar to that of male. Cheek, margin of eye above (on vertex), pronotum and mesopleuron with rusty brown tints. Hind coxa brown. First sternite yellowish, latero-tergites and sternites blackish to brownish. Wings subhyaline.

Variations of the males (6 ♂♂). – Body 3.1–3.5 mm long (3.1: 1 ♂, 3.2: 1 ♂, 3.3: 2 ♂♂, 3.5: 2 ♂♂). Antenna with 33–36 antennomeres (33: 1 ♂, 35: 2 ♂♂, 36: 2 ♂). Propodeum along mediolongitudinal line rugose-rugulose. Second tergite less transverse (1.4–)1.6–1.8 times as wide behind as long medially. Tergites 1–2 rugose, third tergite anteriorly rugulose (3 ♂♂). Head and mesosoma black, coxae black, tegula dark-brown or blackish.

Host unknown.

Distribution: Japan, Korea.

Taxonomic position – *Bracon (Orthobracon) cinctus* (WALKER) is very near to *B. (O.) epitriptus* MARSHALL (Palaearctic Region), the two species are differentiated by the features keyed below:

1 (2) Temple in dorsal view rounded (Fig. 7: ♂) to receded (Fig. 12: ♀). Pterostigma (Figs 10: ♂, 28: ♀) less wide, 3.5–3.7 times as long as wide and issuing radial vein proximally from its middle; *r1* as long as width of pterostigma, *r2* twice to thrice as long as *r1*. Second tergite less transverse, 1.4–1.8 times (Fig. 11: ♂) and twice (Fig. 16: ♀) as wide behind as long medially; sculpture of tergites 1–2 of variable strength, that of female stronger (Figs 11: ♂, 16: ♀). ♀♂: 3–5.1 mm *B. (O.) cinctus* (WALKER)

2 (1) Temple in dorsal view rounded to a variable extent (Figs 17–20: ♀♂), exceptionally receded. Pterostigma (Figs 21: ♀, 22: ♀♂, 27: ♂) wide, 2.2–2.7 times (♀) and 2.5–3.2 times (♂) as long as wide, issuing radial vein from its middle (minute variations possible); *r1* shorter than width of pterostigma, *r2* 2.4–2.8 times (♀) and 2.7–3.2 times (♂) as long as *r1*. Second tergite 2.3–2.5 times (Figs 23–24: ♀) and 1.5–2 times (Figs 25–26: ♂) as wide behind as long medially; sculpture of tergites 1–2 variable in strength, second tergite sculptured usually anteriorly. ♀♂: 2.6–4.5 mm *B. (O.) epitriptus* MARSHALL

Taxonomic remarks – 1. Provancher (1880) described *Phylax cinctus* which was trasferred into the genus *Bracon* by SHENEFELT (1968: 636). The name *Bracon cinctus* (Provancher, 1880) is six years younger than *B. cinctus* (WALKER, 1874), consequently the former name is a junior homonym. Considering the respective instruction of the rules of nomenclature, it seems necessary to resolve

the homonymy therefore I rename PROVANCHER's species as *Bracon provancheri* nom. n.

2. MORLEY's (1913: 134) statement as regards *Hecabolus cinctus*, after having examined its type specimen, is as follows: "Certainly belongs to Marshall's Braconides-cyclostomes, not a Bracon, and perhaps *Hecabolus*: I know nothing like it. One specimen." It is somewhat surprising that C. MORLEY, a well-known braconid specialist, could not recognize the true taxonomic position of this species.

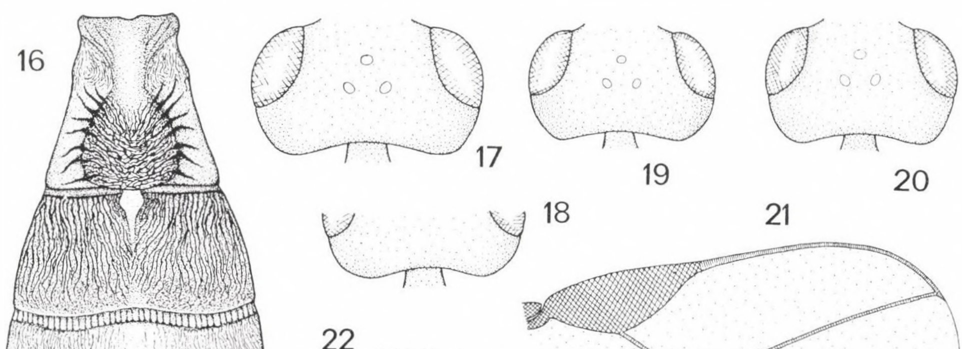
Bracon (Bracon) cisellatus sp. n. ♀
(Figs 6, 29–30)

Material examined. – Holotype ♀: Korea, Prov. Kanwon, Kumgang-san, environs of the hotel, 20 August 1982, leg. BERON et POPOV (loc. No. 12, in manuscript). Paratype (1 ♀): Korea, KyongNam Chinju, Chojeon-dong, taken with mercury vapour lamp at night, 12–13 November 1993, leg. D. S. KU.

Holotype deposited in the Hungarian Natural History Museum (Department of Zoology), Budapest, Hym. Typ. No. 7744, paratype is in the Coll. of DEOK SEO KU, Suewon, Republic of Korea.

Etymology. – The species name "cisellatus" refers to the fine striate sculpture of the tergites 2–5.

Description of the holotype ♀. – Body 3.6 mm long. Head in dorsal view (Fig. 6) transverse, 1.76 times as broad as long, eye 2.4 times as long as temple, latter receded, occiput weakly excavated. Ocelli small and elliptic, OOL 2.4 times as long as POL (Fig. 6, see arrows). Eye in lateral view 1.3 times as high as wide and 1.57 times as wide as temple, temple ventrally broadening. Malar space just shorter than basal width of mandible, circular opening as wide as shortest distance between compound eye and opening. Head polished. – Antenna about one-sixth longer than body and with 27 (right antenna) as well as 26 (left antenna) antennomeres. First flagellomere twice and penultimate flagellomere 1.6 times as long as broad.



Figs 16–22. 16. *Bracon cinctus* (WALKER) ♀: 1–3 tergites. – 7–12. *B. epitriptus* MARSHALL: 17 = head in dorsal view, female paralectotype, 18 = temple and occiput of female, 19–20 = head in dorsal view (19 = male paralectotype, 20 = male), 21 = distal part of right fore wing, female, 22 = second cubital cell (*CU2*) of fore wing, female and male

Mesosoma in lateral view 1.5 times as long as high. Notaulix faintly distinct on declivous fore part of mesonotum. Mesosoma polished. – Hind femur 4.2 times as long as broad medially. Hind tibia as long as hind tarsus, hind basitarsus as long as tarsomeres 2–3.

Fore wing about one-sixth longer than body or as long as antenna. Pterostigma (Fig. 29) 3.3 times as long as wide, issuing radial vein proximally from its middle; r1 a bit shorter than width of pterostigma, *r2* twice as long as *r1* and 1.2 times as long as *cuqu1*, *r3* 2.6 times as long as *r2* and reaching tip of wing. *D1* usual in size, *d* slightly longer than *n. bas.2* (Fig. 29, see arrows).

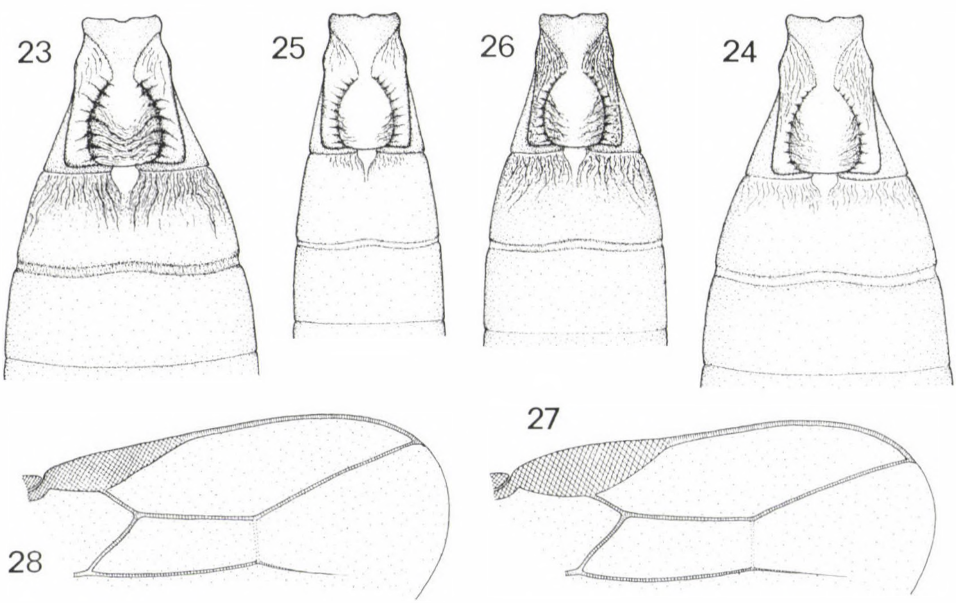
Metasoma somewhat longer than mesosoma and shorter than head + mesosoma combined. First tergite (Fig. 30) as long as broad behind, nearly half as broad basally as at hind, its sides evenly broadening posteriorly, pair of spiracles before middle of tergite, scutum obliquely rugo-striate. Second tergite 1.2 times as long as third tergite, suture between them straight and crenulate. Tergites 2–5 with characteristic fine striation: on second tergite longitudinal (and relatively strong), on third tergite directed from base to laterally, on tergites 4–5 transverse (Fig. 30). Tergites 6–7 smooth and together with former tergites shiny. Ovipositor sheath as long as hind tibia + tarsomeres 1–2 combined or as antenna.

Ground colour of body black. Head brownish yellow, ocellar field blackish, occiput with blackish suffusion. Palpi yellow. Scape and pedicel brownish yellow, flagellum greyish brownish. Line of notaulix and tegula rusty yellow, pronotum rusty yellow with blackish tint. Second suture brownish, tergites 3–7 with very faint rusty tint. Legs yellow, hind tarsus with brownish suffusion. Wings feebly brownish fumous, pterostigma and veins brownish opaque.

Description of the female paratype (1 ♀). – Similar to the holotype. Body 3.8 mm long. Antenna with 26 antennomeres. Pterostigma three times as long as wide. Hind femur 4.4 times as long as broad. Light colour of body somewhat more vivid.

Male and host unknown.

Distribution: Korea.

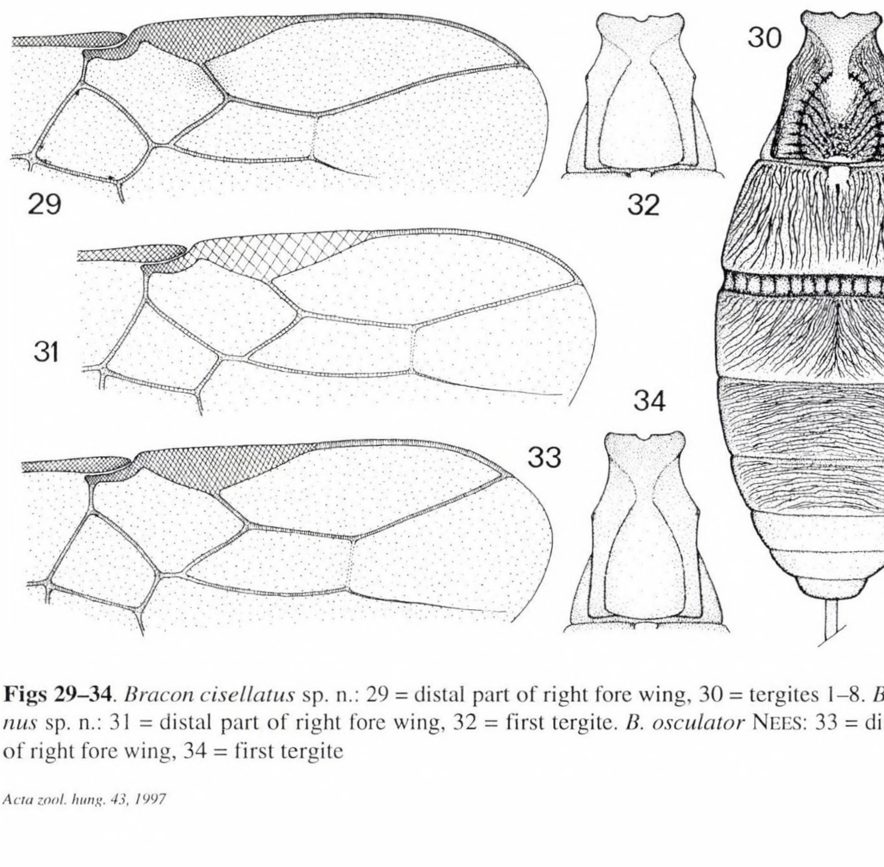


Figs 23–28. *Bracon epitriptus* MARSHALL: 23–26 = tergites 1–3: 23 = paralectotype female, 24 = female, 25 = paralectotype male, 26 = male; 27 = distal part of right fore wing of male. – 28. *B. cinctus* (WALKER): distal part of right fore wing of female

The new species, *Bracon (Bracon) cisellatus* sp. n., is assigned to the subgenus *Bracon* s. str. considering its sculptured, i.e. characteristically striated, tergites 2–5; just this unique fine striation (Fig. 30) differentiates it from all other species belonging to the subgenus *Bracon* within the genus *Bracon* FABRICIUS. It seems reasonable to remark that if further *Bracon* species with similar striation on tergites are discovered in the future it may become necessary to set up a new subgenus to comprise these species.

Bracon (Glabrobracon) koreanus sp. n. ♀ ♂
(Figs 31–32)

Material examined. – Holotype ♀: Korea, Prov. Pyongsung, Beksung-li, Zamo-san, 60 km NE from Pyongyan City, 1–10 August 1975, leg. J. PAPP et A. VOJNITS (loc. No. 331). – Paratypes (4 ♀♀ + 3 ♂♂): 1 ♀: Korea, Prov. South Phenan (= Pyongan), Bongha-ri, on the river Te-dong, 45 km E from Pyongyan City, 23 May 1970, leg. S. MAHUNKA et H. STEINMANN (loc. No. 19). 1 ♀: Korea, prov. Kangwon, near Lake Samil-po, 29 September 1979, leg. H. STEINMANN et T. VÁSÁRHELYI (loc. No. 601). 2 ♀♀: (in Zoological Institute, Warszawa): Korea, Pyongyan City, 12–13 September 1959, leg. B. PISARSKI. 1 ♂: Korea, Prov. South Pyongan, Pyongyan City, Nungra-do, 14 August 1971, leg. S. HORVATOVICH et J. PAPP (loc. No. 175). 1 ♂: Korea, Prov. South Pyongan,



Figs 29–34. *Bracon cisellatus* sp. n.: 29 = distal part of right fore wing, 30 = tergites 1–8. *B. koreanus* sp. n.: 31 = distal part of right fore wing, 32 = first tergite. *B. osculator* NEES: 33 = distal part of right fore wing, 34 = first tergite

Nampo, Wauto, 22 September 1979, leg. H. STEINMANN et T. VÁSÁRHELYI (loc. No. 562). 1 ♂: Korea, Pyongyan City, Botongyang Park, 30 May 1985, leg. A. VOJNITS et L. ZOMBORI (loc. No. 961).

Holotype and five paratypes (2 ♀♀ + 3 ♂♂) deposited in the Hungarian Natural History Museum (Department of Zoology), Budapest, Hym. Typ Nos. 7744 (holotype) and 7745–7749 (paratypes); two paratypes (2 ♀♀) in the Zoological Institute, Polish Academy of Sciences, Warszawa.

Etymology. – The name "koreanus" indicates the country from where the type series of the new species originate.

Description of the holotype ♀. – Body 2.5 mm long. Head in dorsal view 1.9 times as broad as long, eye clearly twice as long as temple, latter rather receded, occiput weakly excavated. Ocelli small and somewhat elliptic, OOL twice as long as POL. Eye in lateral view 1.38 times as high as wide and 1.9 times as wide as temple, latter slightly broadening ventrally. Malar space one-fifth shorter than basal width of mandible. Circular opening horizontally as wide as shortest distance between opening and eye. Head polished. – Antenna one-fifth longer than body and with 30 antennomeres. Flagellum attenuating; first flagellomere twice and penultimate flagellomere three times as long as broad.

Mesosoma in lateral view 1.5 times as long as high. Notaulix indistinct. Prescutellar furrow narrow, shallow and uncrenulate. Mesosoma polished. – Hind femur four times as long as broad medially. Hind tibia as long as hind tarsus, hind basitarsus as long as tarsomeres 2–3 combined.

Fore wing somewhat longer than body. Pterostigma (Fig. 31) 3.3 times as long as wide, issuing radial vein from its middle; *r1* as long as width of pterostigma, *r2* 2.5 times as long as *r1* and 1.66 times as long as *cuqu1*, *r3* straight, 1.5 times as long as *r2* and reaching tip of wing. *D1* somewhat pointed at meeting of *n. bas.2* and *cu1*, *cu1* straight (Fig. 31, see arrow).

Metasoma as long as mesosoma. First tergite (Fig. 32) 1.25 times as long as behind, pair of spiracles at anterior third of tergite, beyond spiracles tergite parallel-sided, margin of scutum uncrenulated. Hind half of tergites 3–5 membraneous, i.e. weakly sclerotized, otherwise tergites sclerotized and polished. Ovipositor sheath as long as fore tibia.

Ground colour of body yellow to reddish yellow. Scape brownish yellow, pedicel and flagellum brownish. Palpi yellow. Ocellar field brown. Mesonotum with three black spots. Propodeum medially, mesosternum and scutum almost entirely brownish. Sclerotized parts of tergites 2–5 black. Legs yellow, tarsi brownish. Wings hyaline, pterostigma opaque yellow, veins yellow with brownish tint.

Description of the female paratypes (4 ♀♀). – Similar to the holotype. Body 2.5–3 mm long (2.5: 1 ♀, 2.8: 2 ♀♀, 3: 1 ♀). Antenna with 29–31 antennomeres. Pterostigma 2.85–3 times as long as wide (2.85: 2 ♀♀, 3: 2 ♀♀). *r1* more or less shorter than width of pterostigma. Dark colour pattern of body more extended (2 ♀♀).

Description of the male paratypes (3 ♂♂). – Similar to the female. Body 2.5–2.6 mm long. (2.5: 2 ♂♂), 2.6: 1 ♂). Antenna with 31 antennomeres. Dark colour pattern of body either brown to dark-brown (1 ♂) or black (2 ♂♂), black colour pattern more extended on mesosoma (2 ♂♂).

Host unknown.

Distribution: Korea.

The new species, *Bracon (Glabrobracon) koreanus* sp. n., is a member of the *B. osculator* species-group within the subgenus *Glabrobracon* FAHRINGER considering the membraneous hind parts of its tergites 2–5. The new species is allied to *B. osculator* NEES, 1812 (Palaearctic Region) and they are distinguished by the following features keyed:

1 (2) *CU2* relatively long, *r2* 1.65 times as long as *cuqu1*, *r3* reaching tip of wing; *D1* somewhat pointed at meeting of *n. bas.2* and *cu1*, *cu1* straight (Fig. 31). First tergite shorter, 1.25 times as long as broad behind (Fig. 32).

Pterostigma yellow, ground colour of body yellow to reddish yellow with black(ish) pattern on mesonotum and tergites 2–5(–6). ♀ ♂: 2.5–3 mm

B. (Gl.) koreanus sp. n.

2 (1) *CU2* relatively shorter, *r2* 1.35–1.4 times as long as *cuqu1*, *r3* approaching tip of wing, *D1* not pointed at meeting of *n. bas.2* and *cu1*, *cu1* faintly convex (Fig. 33). First tergite long, 1.55–1.65 times as long as broad behind (Fig. 34). Pterostigma opaque brown to dark brown, ground colour of body black, at most (anterior) sternites yellow to reddish yellow. ♀ ♂: 1.8–3 mm

B. (Gl.) osculator NEES

Bracon (Foveobracon) nodulosus sp. n. ♀ ♂
(Figs 35–41)

Material examined. – Holotype ♀: Korea, Prov. Kangwon, Kumgang-san, Samil-po, 18 km June 1988, leg. O. MERKL et GY. SZÉL (loc. No. 1324). – Paratypes (2 ♀ ♀ + 1 ♂): 1 ♀ + 1 ♂: Korea, Kaesong City, Pakyon Mts, Pakyon popo, 27 km NE from Kaesong City, 1 ♀: 7 June 1970, leg. S. MAHUNKA et H. STEINMANN (loc. No. 100), 1 1 ♀: 10–12 September 1971, leg. S. HORVATOVICH et J. PAPP (loc. No. 257).

Holotype and two paratypes deposited in the Hungarian Natural History Museum (Department of Zology), Budapest, Hym. Typ. Nos 7751 (holotype) and 7752–7753 (paratypes).

Etymology. – The species name "nodulosus" refers to the nodiform protuberance of the first tergite.

Description of the holotype ♀. – Body 2.2 mm long. Head in dorsal view (cf. Fig. 1) transverse, 1.83 times as broad as long, eye twice as long as temple, latter receded, occiput weakly excavated. Ocelli small and elliptic, OOL twice as long as POL (cf. Fig. 1, see arrows). Eye in lateral view 1.35 times as high as wide and just less than twice as wide as temple, temple evenly broad behind eye (cf. Fig. 2). Malar space one-fourth longer than basal width of mandible, circular opening one-quarter less wide than shortest distance between eye and opening. Head polished. – Antenna somewhat longer than body and with 19 antennomeres. Flagellum faintly attenuating distally. First flagellomere distinctly three times and penultimate flagellomere 2.75 as long as broad.

Mesosoma in lateral view 1.45 times as long as high. Notaulix almost indistinct. Mesosoma polished; propodeum also polished and with a medio-longitudinal sulcus (Fig. 35). Hind femur 3.9 times as long as broad somewhat distally. Hind tibia as long as hind tarsus; hind basitarsus a bit shorter than tarsomeres 2–4 combined.

Fore wing about one-fifth longer than body. Pterostigma (Fig. 36) three times as long as wide, issuing radial vein proximally from its middle; *r1* a bit shorter than width of pterostigma, *r2* twice as long as *r1* and as long as *cuqu1*, *r3* twice as long as *r2*, faintly arched or just not straight and reaching tip of wing. *D1* relatively long, *d* 1.27 times as long as *n. bas.2*, latter vein 1.6 times as long as *n. rec.*

Metasoma about as long as head + mesosoma combined. First tergite (Fig. 37) one-fifth longer than broad behind, pair of spiracles on a rather upwards directed and nodiform protuberance, protuberance anteriorly on tergite, lateral margin of scutum strongly crenulate (Fig. 37–38). Second tergite less transverse and 1.8 times as long as third tergite, its middle field extending about anterior two-thirds of tergite, together with further tergites polished. Suture between tergites 2–3 bisinuate and finely crenulate. Ovipositor sheath somewhat longer than hind basitarsus (but shorter than basitarsus + second tarsomere). Posterior end of ovipositor as in Fig. 41.

Ground colour of body black with very feeble brownish tint. Palpi yellow. Scape and pedicel brownish, flagellum dark greyish blackish. Tegula and legs brownish yellow. Tergites 2–3 laterally indistinctly rusty. Wings subhyaline or faintly fumous, pterostigma and veins brownish.

Descripton of the female paratype (1 ♀). – Similar to the holotype. Body 1.9 mm long. Head in dorsal view 1.84 times as broad as long. Antenna with 18 antennomeres. Pterostigma 3.3 times as long as wide. Ovipositor sheath as long as hind basitarsus + second tarsomere combined. Ground colour of body dark brown, legs yellow.

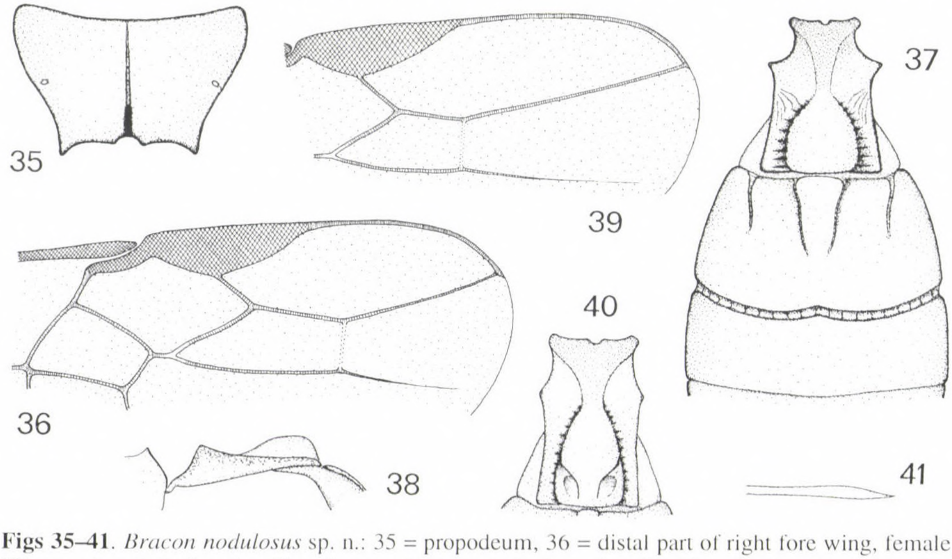
Description of the male paratype (1 ♂). – Similar to the female paratype. Body 2 mm long. Head in dorsal view 1.92 times as broad as long. Antenna with 19 antennomeres. Pterostigma (Fig. 39) three times as long as wide, issuing radial vein more proximally from its middle; *CU2* short, i.e. *r2* a bit shorter than *cuqu1*, *r3* straight and four times as long as *r2*. First tergite (Fig. 40) 1.5 times as long as broad behind and almost parallel-sided, pair of protuberances less protruding, scutum posteriorly with a pair of foveolae, inner margin of foveolae partly carinated. Crenulation of sutures 2–4 stronger.

Host unknown.

Distribution: Korea.

Within the subgenus *Foveobracon* TOBIAS the new species, *Bracon (Foveobracon) nodulosus* sp. n., is nearest to *B. (F.) flaccus* PAPP, 1996 (Korea), for their distinction see key-couplets 5 (6) – 7(8), p. 108. With the key of the *Bracon* FABRICIUS species by TELENGA (1936) the new species runs to *B. (Glabrobracon) brevis* TELENGA, 1936 (China: Setchuan)*, the females of the two species are distinguished by the following features keyed:

1 (2) First tergite 1.5 times as long as broad behind, laterally without a pair of nodiform protuberances. *CU2* of fore wing long, *r2* almost three times as



Figs 35–41. *Bracon nodulosus* sp. n.: 35 = propodeum, 36 = distal part of right fore wing, female, 37 = tergites 1–3, female, 38 = first tergite in lateral view, female, 39 = distal part of right fore wing, male, 40 = first tergite, male, 41 = posterior end of ovipositor

* *Bracon brevis* is known to me based on its original description (TELENGA 1936: 214, in key: 150).

long as *r1* and *r3* 1.5 times as long as *r2*. Ovipositor sheath as long as metasoma. Body and legs black, palpi reddish yellow. ♀: 4 mm.

B. (Gl.) brevis TELENGA

2 (1) First tergite (Figs 37, 40) 1.2–1.5 times as long as broad behind, laterally with a pair of nodiform protuberances. Female: *CU2* of fore wing short, *r2* twice as long as *r1* and *r3* also twice as long as *r2* (Fig. 36); male: *CU2* shorter (Fig. 39). Ovipositor sheath at most as long as half metasoma. Body brownish black to dark brown, legs and palpi yellow. ♀ ♂: 1.9–2.2 mm

B. (Gl.) nodulosus sp. n.

Bracon (Glabrobracon) patens sp. n. ♀
(Figs 42–45)

Material examined. – Holotype ♀: Korea, Prov. South Pyongan, Nampo, 19 July 1975, leg. J. PAPP et A. VOJNITS (loc. No. 273). – 1 ♂ (without paratypic status: heavily damaged, i.e. mesosoma transversely cracked, left occiput of head impressed): Korea, Gyeong Nam Chinju, Chojeon-Dong City, taken with lamp at night, 7–8 July 1993, leg. DEOK SEO KU.

Holotype deposited in the Hungarian Natural History Museum (Department of Zoology), Budapest, Hym. Typ. No. 7750; one male specimen in the Coll. of Deok Seo Ku, Suewon, Republic of Korea.

Etymology. – The species name "patens" refers to the obvious and close relation to its nearest ally *B. bellicolor*.

Description of the holotype ♀. – Body 5 mm long. Head in dorsal view (Fig. 42) transverse, 1.75 times as broad as long, eye twice as long as temple, latter somewhat receded, occiput moderately excavated. Ocelli small and just not round, OOL three times as long as POL (Fig. 42, see arrows). Eye in lateral view 1.3 times as high as wide and twice as wide as temple, temple almost evenly broad behind eye. Malar space one-fourth shorter than basal width of mandible. Circular opening horizontally 1.36 times as wide as shortest distance between opening and eye. Head polished. – Antenna somewhat longer than body and with 40 antennomeres. Flagellum attenuating, first flagellomere 2.2 times and penultimate flagellomere 2.4 times as long as broad.

Mesosma in lateral view 1.7 times as long as high. Notaulix weak and shallowing posteriorly. Prescutellar furrow narrow and crenulate. Mesosoma polished. – Hind femur (Fig. 43) three times as long as broad distally. Hind tarsus a bit longer than hind tibia; hind basitarsus as long as tarsomeres 2–3 combined.

Fore wing as long as body. Pterostigma (Fig. 44) three times as long as wide, issuing radial vein from its middle; *r1* shorter than width of pterostigma, *r2* 2.4 times as long as *r1* and somewhat longer than *cuqu1*, *r3* straight, 1.7 times as long as *r2* and reaching tip of wing. *D1* usual in form, *cu1* 1.45 times as long as *n. bas.2*.

Metasoma as long as head + mesosoma combined. First tergite (Fig. 45) as long as broad behind, pair of spiracles before its middle, beyond spiracles tergite subparallel-sided, i.e. hardly broadening. Second and third tergites equal in length, suture between them faintly arched and smooth (i.e. uncrenulate). Every tergite polished. Ovipositor sheath long, as long as hind tibia + basitarsus or almost as long as metasoma. Hypopygium pointed.

Head and mesosoma black. Scape and pedicel brownish yellow, flagellum brownish. Cheek and oral organs yellow. Margin around eye brownish yellow. Tegula yellow. Pronotum and mesopleuron with faint rusty tint. Legs yellow, claws + pulvilli blackish. Ground colour of metasoma

yellow, first tergite black. Blackish streak of tergites 2–6 broadening posteriorly. Wings brownish fumous, pterostigma and veins brownish.

Male. – Similar to the female holotype. Body 3.5 mm long. Antennae with 35 (left antenna) and 34 (right antenna) antennomeres. Black colour somewhat more extended.

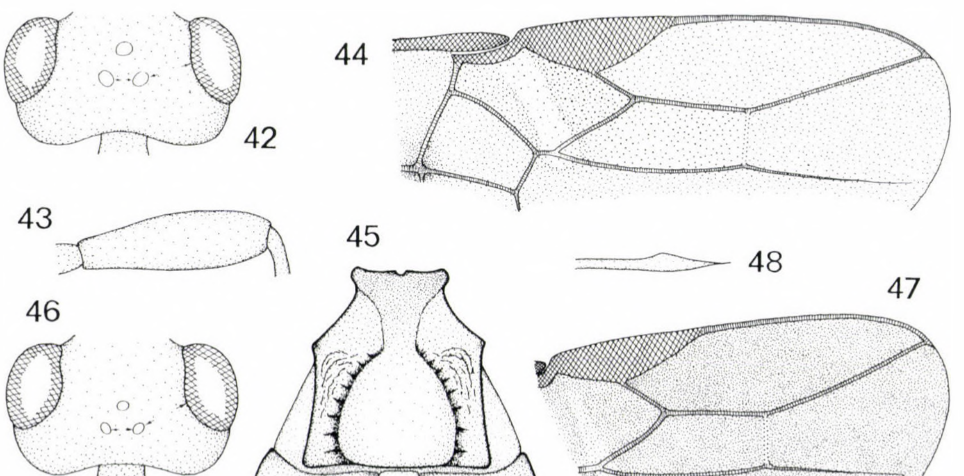
Host unknown.

Distribution: Korea.

The new species, *Bracon (Glabrobracon) patens* sp. n., is allied to *B. (Gl.) bellicolor* PAPP, 1996 (Korea), the two species are separated by the following features:

1 (2) Head in dorsal view (Fig. 42) transverse, 1.8 times as broad as long, temple somewhat receded. First tergite as long as broad behind (Fig. 45). Pterostigma issuing radial vein from its middle, *r2* only somewhat longer than *cuqu1* (Fig. 44). Hind femur three times as long as broad distally. Ovipositor sheath long, as long as hind tibia + basitarsus combined. Face blackish, laterally along eye and above close to scape brownish yellow. ♀: 5 mm
B. (Gl.) patens sp. n.

2 (1) Head in dorsal view (Fig. 13 in PAPP 1996: 158) somewhat less transverse, 1.66 times as broad as long, temple rounded. First tergite 1.45 times as long as broad behind (Fig. 16 l. c.). Pterostigma issuing radial vein somewhat proximally from its middle, *r2* distinctly one-third longer than *cuqu1* (Fig. 15 l. c.). Hind femur 3.3 times as long as broad medially. Ovipositor sheath short, as long as hind basitarsus. Face yellow. ♀: 3.8 mm
B. (Gl.) bellicolor PAPP



Figs 42–48. *Bracon patens* sp. n.: 42 = head in dorsal view, 43 = hind femur, 44 = distal part of right fore wing, 45 = first tergite. *B. pinguis* sp. n.: 46 = head in dorsal view, 47 = distal part of right fore wing, 48 = posterior end of ovipositor

Bracon (Foveobracon) pinguis sp. n. ♀
(Figs 46–49)

Material examined. – Holotype ♀ + 1 ♀ paratype: Korea, Prov.Kengi, Pakyon Mts, Sanchon-tong, about 20 km SE from Kaesong, 8 June 1970, leg. S. MAHUNKA et H. STEINMANN (loc. No. 112). – Holotype and one paratype deposited in the Hungarian Natural History Museum (Departnent of Zoology), Budapest, Hym. Typ. Nos 7754 (holotype) and 7755 (paratype).

Etymology. – The name "pinguis" (=fat) refers to the bellied metasoma of the species.

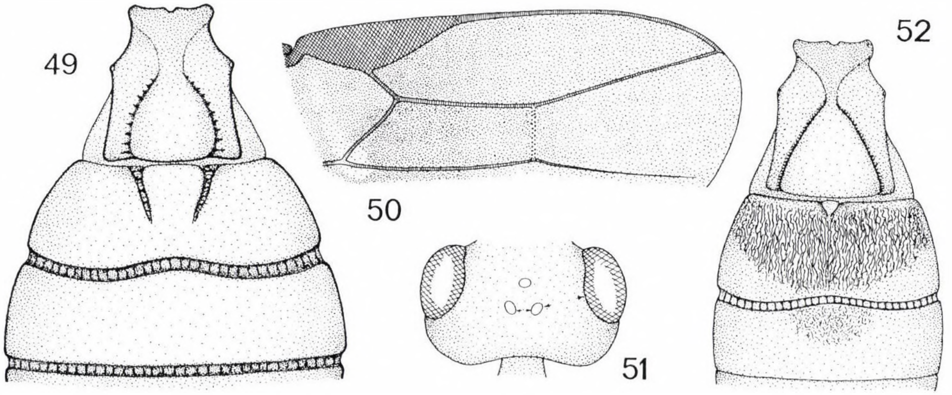
Description of the holotype ♀. – Body 2.6 mm long. Head in dorsal view (Fig. 46) transverse, 1.7 times as broad as long, eye 1.9 times as long as temple, latter rounded, occiput hardly excavated. Ocelli small and elliptic. OOL just less than twice as long as POL (Fig. 46, see arrows); ocelli small and unusually posteriorly on vertex, i.e. pair of hind ocelli on the imaginary line between hind points of compound eyes (ocelli usually distinctly before this line). Eye in lateral view 1.6 times as high as wide and 1.35 times as wide as temple, temple evenly broad behind eye. Malar space somewhat shorter than basal width of mandible, circular opening horizontally 1.6 times as wide as shortest distance between opening and eye. Head polished, face laterally faintly uneven. – Antenna about as long as body and with 24 antennomeres. First flagellomere twice and penultimate flagellomere 1.8 times as long as broad.

Mesosoma in lateral view 1.4 times as long as high. Notaulix distinct and weak. Mesosoma polished. – Hind femur three times as long as broad medially. Hind tibia as long as hind tarsus, hind basitarsus as long as tarsomeres 2–4.

Fore wing slightly longer than body. Pterostigma (Fig. 47) four times as long as wide, issuing radial vein just proximally from its middle; *r1* just longer than width of pterostigma, *r2* 2.27 times as long as *r1* and a bit longer than *cuqu1*, *r3* 1.6 times as long as *r2* and reaching tip of wing. *D1* of fore wing usual in size, *d* minutely longer than *n. bas.2*.

Metasoma bellied and as long as mesosoma. First tergite (Fig. 49) hardly longer than broad behind, beyond spiracles tergite weakly broadening, scutum polished. Second tergite as long as third tergite, suture between them feebly bisinuate and finely crenulate. Antero-median field of tergite fairly large and laterally bordered with a pair crenulate furrows (Fig. 49), second and further tergites polished. Ovipositor sheath as long as middle tibia. Posterior end of ovipositor as in Fig. 48.

Body dark-brown with faint rusty tint on propodeum and metasoma. Sternites 1–2 straw yellow, further sternites brown. Circular opening and oral organs brownish yellow. Tegula brown. Legs brownish yellow, coxae 2–3 brown. Wings brownish fumous, pterostigma and veins opaque brown.



Figs 49–52. 49 = *Bracon pinguis* sp. n.: tergites 1–3. 50 = *B. biimpressus* TELENGA: distal part of right fore wing. *B. trilateris* sp. n.: 51 = head in dorsal view, 52 = tergites 1–3

Description of the female paratype (1 ♀). – Similar to the holotype. Body 2.4 mm long. Head in dorsal view 1.66 times as broad as long. Antenna with 23 antennomeres. Hind femur 3.4 times as long as broad. Head and mesosoma brownish black, metasoma dark-brown.

Male and host unknown.

Distribution: Korea.

Within the subgenus *Foveobracon* TOBIAS the new species, *B. (F.) pinguis* sp. n., is allied to *B. (F.) biimpressus* TELENGA, 1936 (European part of Russia, Bohemia), the two species are distinguished in the key-couplets 1(4)–3(2), p. 107–108.

KEY TO THE SPECIES OF THE SUBGENUS FOVEOBRACON TOBIAS (GENUS BRACON FABRICIUS)

1 (4) Second and third tergites equal in length (Fig. 49). In dorsal view temple rounded (Fig. 46; Fig. 32 in PAPP 1996: 158).

2 (3) *CU2* of fore wing long, *r2* 1.7–1.8 times as long as *cuqu1* and *r3* 1.35–1.45 times as long as *r2* (Fig. 50). Second tergite laterally from antero-median field foveolate-form impressed (Fig. 68: 12 in TOBIAS 1986: 120), first tergite 1.25 times as long as broad behind. Frons densely shagreened. Antenna with 39–40 antennomeres. Head and mesosoma black, metasoma yellow with a median blackish streak, first tergite black. ♀: 4–5 mm
B. (F.) biimpressus TELENGA

3 (2) *CU2* of fore wing short, *r2* a bit longer than *cuqu1* and *r3* 1.6 times as long as *r2* (Fig. 47). Second tergite laterally from antero-median field sulciform impressed (Fig. 49), first tergite hardly longer than broad behind. Frons polished. Antenna with 23–24 antennomeres. Body brown with less distinct rusty tint. ♀: 2.4–2.6 mm **B. (F.) pinguis** sp. n.

4 (1) Second tergite more or less longer than third tergite (Fig. 37; Fig. 31 in PAPP 1996: 161). In dorsal view temple more or less receded (Fig. 1; Fig. 28 in PAPP 1996: 158)

5 (6) First tergite antero-laterally with a pair of rather upwards directed and nodiform protuberance (Fig. 37: ♀), that of male less protruding (Fig. 40). Propodeum with medio-longitudinal sulcus, otherwise polished (Fig. 35). Vein *r2* as long as *cuqu1* (Fig. 36: ♀) or a bit shorter than *cuqu1* (Fig. 39: ♂) Body rusty brown, legs yellow. ♀ ♂: 1.9–2.2 mm
B. (F.) nodulosus sp. n.

6 (5) First tergite without nodiform protuberance. Propodeum without sulcus, polished.

7 (8) *CU2* of fore wing conspicuously short, i.e *r2* and *cuqu1* equal in length and *r3* more than three times as long as *r2* (Fig. 30 in PAPP 1996: 161). Ovipositor sheath long, as long as antenna. Body brown, legs yellow. ♀: 3 mm

B. (F.) flaccus PAPP

8 (7) *CU2* of fore wing usual in length, i.e. *r2* about 1.3 times as long as *cuqu1* and *r3* 1.3–1.4 times as long as *r2* (Fig. 33 in PAPP 1996: 161).

9(10) First tergite 1.4–1.5 times as long as broad behind, laterally from scutum crenulation relatively less strong; median field of second tergite less broad and around it rugulose surface more extended (Fig. 34 in PAPP 1996: 161). Head and mesosoma black, metasoma yellow with brownish median streak of variable extent, legs straw yellow. ♀ ♂: 2.5–3 mm

B. (F.) plugarui TOBIAS

10 (9) First tergite only a bit longer than broad behind, laterally from scutum crenulation relatively strong; median field of second tergite broad and around it rugulose surface somewhat less extended (Fig. 4). Body black with rich brownish yellow pattern, legs brownish yellow. ♀: 2.5–2.6 mm

B. (F.) belokobylskiji sp. n.

Bracon (Glabrobracon) trilateris sp. n. ♀
(Figs 51–55)

Material examined. – Holotype ♀: Korea, Prov. Kanwon, Kumgang-san, Samil-po, 1 June 1970, leg. S. MAHUNKA et H. STEINMANN (loc. No. 87). – Holotype deposited in the Hungarian Natural History Museum (Department of Zoology), Budapest, Hym. Typ. No. 7756.

Etymology. – The species name "trilateris" refers to the three-sided scutum of the first tergite.

Description of the holotype ♀. – Body 2.2 mm long. Head in dorsal view (Fig. 51) 1.77 times as broad as long, eye 1.8 times as long as temple, latter rounded, occiput weakly excavated. Ocelli small, POL almost half as long as OOL (Fig. 51, see arrows). Eye in lateral view 1.55 times as high as wide and 1.28 times as wide as temple. Malar space about as long as basal width of mandible, circular opening horizontally 1.4 times as wide as shortest distance between opening and eye. Head polished, face laterally sparsely subpunctate. – Antenna about as long as body and with 23 antennomeres. First flagellomere 2.4 times and penultimate flagellomere twice as long as broad.

Mesosoma in lateral view 1.66 times as long as high. Notaulix almost indistinct. Mesosoma polished; propodeum postero-medially with a short carina (Fig. 54). – Hind femur 3.3 times as long as broad medially. Hind tibia as long as hind tarsus. Hind second tarsomere as long as fifth tarsomere.

Fore wing as long as body. Pterostigma (Fig. 53) 2.65 times as long as wide, issuing radial vein somewhat proximally from its middle; *r1* somewhat shorter than width of pterostigma, *r2* twice as long as *r1* and as long as *cuqu1*, *r3* twice as long as *r2* and reaching tip of wing, *n. rec.* somewhat antefurcal.

Metasoma about as long as head + mesosoma combined. First tergite (Fig. 52) just longer than broad behind, pair of spiracles before middle of tergite, beyond spiracles tergite moderately

broadening, scutum of tergite distinctly triangular or three-sided. Second tergite 1.2 times as long as third tergite, suture between them bisinuate and crenulate (Fig. 52). First tergite: scutum polished, lateral part uneven to smooth, shiny; second tergite: longitudinally rugulo-striate, shiny; third tergite: uneven to smooth, antero-medially subrugulose; further tergites polished. Ovipositor sheath somewhat shorter than hind tibia. Posterior end of ovipositor as in Fig. 55.

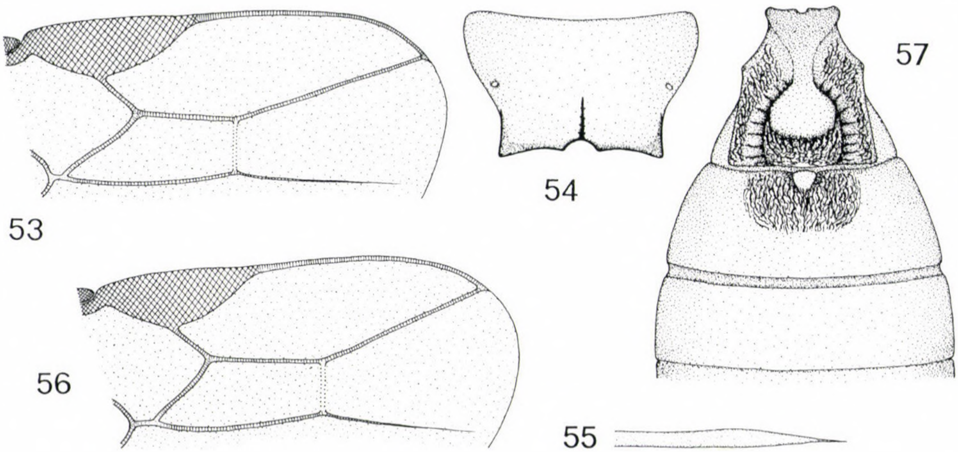
Ground colour of body chestnut brown. Cheek and lower part of temple yellow. Face brown, laterally and above brownish yellow. Oral organs straw yellow. Scape, pedicel and flagellomeres 1–3 brownish yellow, rest of flagellum greyish brownish. Notaulix and pronotum brownish yellow, lateral wing of pronotum medially brown. Tegula, sternites and legs yellow. Wings hyaline, pterostigma and veins brownish.

Male and host unknown.

Distribution: Korea.

The new species, *B. (Gl.) trilateris* sp. n.), is nearest to *B. (Gl.) titubans* WESMAEL, 1838 (Europe), the two species are distinguished by the following features keyed:

1 (2) Scutum of first tergite either more or less five-sided or with arched sides, scutum posteriorly and margin of tergite rugose; second tergite antero-medially with longitudinal rugulosity, suture between tergites 2–3 either straight or faintly (i.e. indistinctly) bisinuate, smooth (i.e. not crenulate) (Fig. 57). *CU2* long, i.e. *r2* about one-fourth longer than *cuqu1*, *r3* less than twice as long as *r2* (Fig. 56). Cheek and lower part of temple brown to dark brown. ♀ ♂: 2.5–3 mm *B. (Gl.) titubans* WESMAEL



Figs 53–57. *Bracon trilateris* sp. n.: 53 = distal part of right fore wing, 54 = propodeum, 55 = posterior end of ovipositor. *B. titubans* WESMAEL: 56 = distal part of right fore wing, 57 = tergites 1–3

2 (1) Scutum of first tergite distinctly three-sided or triangular, scutum and margin of tergite smooth, shiny; second tergite nearly entirely and longitudinally rugulo-striate, suture between tergites 2–3 bisinuate and crenulate (Fig. 52). *CU2* less long, i.e. *r2* and *cuqu1* equal in length, *r3* twice as long as *r2* (Fig. 53). Cheek and lower part of temple yellow. ♀: 2.2 mm
B. (Gl.) trilateris sp. n.

* * *

Acknowledgement – I am much indebted to Dr T. HUDDLESTON (The Natural History Museum, London) who kindly borrowed the type specimen of Hecabolus cinctus WALKER.

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A REVIEW OF MIMOBORCHMANIA PIC (COLEOPTERA, TENEBRIONIDAE: LAGRIINI)*

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The lagriine genus *Mimoborchmania* PIC, 1934 and its type species, *M. coloripes* (PIC, 1922) are redescribed. *M. yangi* sp. n. is described from China, Thailand and Vietnam. Notes on a possible mimetic complex are given. A key for the identification of the two species is presented. With 10 figures.

Key words: taxonomy, Coleoptera, Tenebrionidae, Lagriini, *Mimoborchmania*, Oriental, ovipositor, female genital tube, mimicry

INTRODUCTION

The lagriine genus *Mimoborchmania* was erected by PIC (1934) for *Nemostira coloripes* PIC, 1922 and its three colour varieties from Tonkin. In his monograph on World "Lagriidae", BORCHMANN (1937) presented a more detailed redescription of the genus (under the unjustifiably emended name of *Mimoborchmannia*) and repeated PIC's description of the species and varieties. There is nothing else to say about the history of this genus.

Recently, the two authors independently came across specimens which represent a new species of *Mimoborchmania*. Having surveyed the Insect Collection of the Institute of Zoology, Academia Sinica (Beijing), the junior author discovered six specimens from Yunnan Province, China. In materials collected recently in Thailand and Vietnam, the senior author found a number of specimens which are apparently conspecific with the Chinese ones.

This paper is devoted to the description of the new species, redescription of the genus and *M. coloripes* and a key to the two species.

The following acronyms are used in the text for indicating depositories of the investigated specimens: BMNH – The Natural History Museum, London, United Kingdom; IASB – Institute of Zoology, Academia Sinica, Beijing, China; HNHM – Hungarian Natural History Museum, Budapest, Hungary; MASU – private collection of Dr. K. MASUMOTO, Yokohama, Japan; NHMW – Naturhistorisches Museum, Wien, Austria; NSMT – National Science Museum (Natural History), Tokyo, Japan; SMNS – Staatliches Museum für Naturkunde, Stuttgart, Germany; SWAU – Insect Collection, Southwest Agricultural University, Chongqing, China.

* 11th contribution to the knowledge of Lagriini (series by O. MERKL).

Mimoborchmania PIC, 1934

Mimoborchmania PIC, 1934: 31.
Mimoborchmannia BORCHMANN, 1937: 490. [Unjustified emendation.]

Type species. Nemostira coloripes PIC, 1922, by original monotypy.

Redescription. Body elongate, convex, shiny, nearly glabrous, integument usually bicoloured (red and black).

Head elongate; frontoclypeal suture deep; frons with two longitudinal grooves slightly converging posteriorly; genae prominent; vertex with variably developed impression or fovea; eyes widely separated, moderately prominent, genal canthus encroaching to 1/4 of eye width; antennae robust but antennomeres 3–11 not transverse; last segment of maxillary palp hatchet-shaped; last segment of labial palp spindle-shaped with apex not emarginate.

Prothorax wider than long; pronotum subglobular, without lateral carina, widest just anterior to middle, constricted before base; sides arcuate, anterior margin straight, basal margin slightly curved posteriorly; pronotosternal suture straight, vaguely indicated; prosternal process narrow, strongly declivous behind procoxae. Scutellum tongue-shaped, flat, impunctate.

Elytra subparallel-sided, disc convex, humeral callosity moderately prominent, apex rounded; combined width about 2x wider than pronotum; with short scutellary striola and 10 striae consisting of coarse, quadrate punctures; interstriae feebly costate, with very few setigerous punctures restricted to odd-numbered interstriae; even-numbered and odd-numbered interstriae subequal in convexity; epipleural carina reaching apex.

Hind wings with first anal cross-vein present.

Metendosternite (Fig. 8) with stalk and arms relatively narrow; stalk somewhat shorter than arms; laminae medium-sized; anterior tendons subapical.

Legs moderately long; femora feebly clavate, hind femora reaching hind margin of 3rd abdominal sternite; tibiae narrow, straight, feebly widening toward apex; tarsi somewhat shorter than tibiae.

Spiculum ventrale completely fused distally, forming a non-forked rod (Fig. 4). 8th abdominal tergite of female entire (Figs 9–10), 8th abdominal sternite of female divided into two sclerites (Fig. 5).

Ovipositor (Fig. 3) with paraprocts elongate, as long as coxites; baculi of paraprocts longitudinal; baculi of 1st coxite lobe transverse; 1st lobe short, 4th lobe free but short and flattened; limits of 1st, 2nd and 3rd lobes vague, so lobation indistinct; gonostyli terminal; proctiger nearly twice longer than paraprocts; distal end of proctigeral baculi situating far before base of coxites.

Female genital tube (Fig. 3) with large primary bursa copulatrix and long spermathecal gland; base of bursa copulatrix with many small sclerites arranged in a ring.

Sexual dimorphism. Last antennomere of male longer than that of female; last abdominal sternite rounded apically in male, slightly impressed in female.

Distribution. Oriental Region. The specimens available for study come from the following countries: China, Thailand, Laos and Vietnam.

Remarks. Mimoborchmania is a member of a group of genera of the subtribe Statirina which contains subcylindrical forms with robust antennae and narrow and more or less costate elytral interstriae. Apart from *Mimoborchmania*, this group includes *Borchmannia* PIC, 1912, *Falsonemostira* PIC, 1917, *Rouyerus* PIC, 1911 and probably *Pseudocasnonidea* BORCHMANN, 1937. As emphasized by MERKL (1988), delimitation of these genera is far from clear-cut. The separation of the genera is based mainly on vague differences in the development of elytral costae and the shape of antennae. However, the separation is inconsistent

in several cases. For instance, BORCHMANN (1937) distinguished *Mimoborchmania* from *Borchmannia* by the thickness of antennae (*Mimoborchmania*: "Fühler ... sind nicht abgeplattet und gegen die Spitze wenig or nicht verdickt"; *Borchmannia*: "Fühler abgeplattet"; "Fühler ... nach aussen ziemlich stark und gleichmszig verdickt"). In reality, however, paratype specimens of *Borchmannia nigrifinis* BORCHMANN, 1929 and *B. suturalis* BORCHMANN, 1937 (studied by the senior author) have antennae definitely narrower than those of any specimens of *Mimoborchmania*.

As for the female tube, *Mimoborchmania* apparently belongs to the least derived branch in the phylogeny of the female tube (*Anaedus* type of TSCHINKEL & DOYEN 1980: 336–337, 361) in which a constriction of the primary bursa copulatrix separates a large distal sac. The female genital tube is somewhat similar to that of *Phymatestes exsculptus* depicted by TSCHINKEL & DOYEN (1980: 339, Fig. 19A) in that the base of the enlarged sac has a number of small sclerites. The ovipositor fits more or less the toxicine type (general configuration is primitive but paraprocts are elongate and 4th coxite lobe is flattened).

Mimoborchmania yangi sp. n.
(Figs 1, 3–9)

Material examined. Holotype, male (HNHM), labelled as follows: "Thailand, Doi Sang, nr Chiang Mai, 5. VI. 1993, leg. K. Kume & H. Ito" [laser-printed on white paper]; "HOLOTYPUS ♂ *Mimoborchmania yangi* MERKL et CHEN, 1997" [printed and handwritten with black on red paper]. Paratypes. THAILAND: same as holotype (1 ♂, 1 ♀, BMNH; 10 ♂♂, 22 ♀♀, HNHM; 1 ♀, MASU; 1 ♂, NSMT; 1 ♂, SMNS); Chiang Mai, Samseng, 1. V. 1988, A. YAMASHITA (1 ♂, HNHM); Chiang Mai, V. 1988, native collector (9 ♂♂, 10 ♀♀, HNHM; 1 ♂, MASU; 1 ♀, NSMT; 1 ♀, SMNS; 1 ♂, 1 ♀, SWAU); Ban Nang Bang, near Sai Yok N.P., Kanchanaburi Prov., West Thailand, 12. V. 1985, H. AKIYAMA (1 ♀, HNHM); 19.19 N, 97.59 E, Mae Hong Son, Ban Huai Po, 1600–2000 m, 9–16. V. 1991, L. DEMBICKY (1 ♂, 1 ♀, NHMW); Meo Village, N. Thailand, 25. V. 1978, K. AKIYAMA (1 ♂, HNHM); ditto, 29. V. 1978 (1 ♀, HNHM); ditto, 31. V. 1978 (1 ♀, HNHM). – CHINA: Yunnan, Cheli, 640 m, 29. IV. 1957, WANG SHUYONG (1 ♂, IASB); Yunnan, Jinghong, 850 m, 19. VI. 1957, WANG SHUYONG (2 ♂♂, 2 ♀♀, IASB); Yunnan, Menghai, 650 m, 15. VI. 1958, HONG CHUNPEI (1 ♀, IASB). VIETNAM: South Vietnam, Buon Ma Thuot, 5–11. V. 1991, H. ITO (5 ♂♂, 1 ♀, HNHM). – All paratypes are tagged with the following label: "PARATYPUS ♂ [or] ♀ *Mimoborchmania yangi* MERKL et CHEN, 1997" [laser-printed on yellow paper with the sex-mark handwritten].

Description. Male (holotype). Length 11.2 mm. Head black with upper surface of mandibles and an indistinct spot behind eyes reddish; antennae black, apex of last segment vaguely reddish; pronotum yellowish red; scutellum black; elytra yellowish red with apical 1/20 black; prosternum reddish in front of procoxae and black behind; meso- and metasternum and abdominal sternites black; legs black with basal 1/6 of middle and hind femora and middle and hind tibiae yellowish. Habitus: Fig. 1.

Head length-to-width ratio as 1.3 : 1; surface impunctate, except few punctures at anterior corner of eyes, on clypeus and on anterior half of labrum; vertex with a longitudinal fovea; interocular distance 1.5x eye diameter; temples with shallow but distinct impression behind eyes; anten-

nae exceeding elytral humerus; antennal segment length ratios as 16 : 10 : 18 : 17 : 18 : 15 : 17 : 15 : 13 : 11 : 61.

Prothorax length-to-width ratio as 1.02 : 1; pronotum convex, each side of disc with an indistinct, rounded pit; disc impunctate, except few very fine punctures toward hypomeron and in prebasal constriction; hypomeron and prosternum with very fine transverse wrinkles. Mesosternum smooth mesally, with fine punctures laterally. Mesepisternum with scattered, coarse punctures. Mesepimeron smooth. Metasternum smooth mesally, with few punctures toward lateral margin. Metepisternum with few punctures mainly in anterior half.

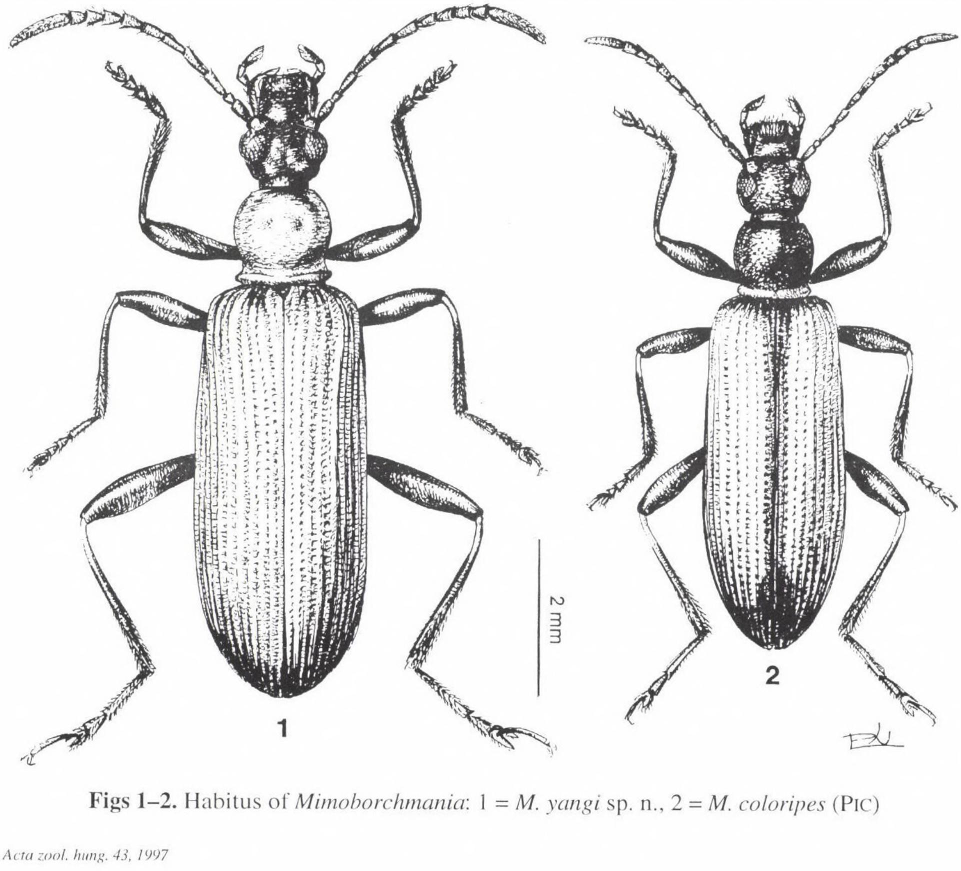
Elytra 1.6x wider than pronotum. Elytral epipleura impunctate. Elytral interstriae with setigerous punctures as follows: interstria 1with 5 (3 in basal 1/6, 2 in apical 1/10), interstria 3 with 5 (1 in basal 1/4, 4 in apical 1/4), interstria 9 with 2 (in apical 1/10) punctures.

Abdominal sternites impunctate, except few fine punctures in lateral impressions.

Male genitalia as in Figs 6–7.

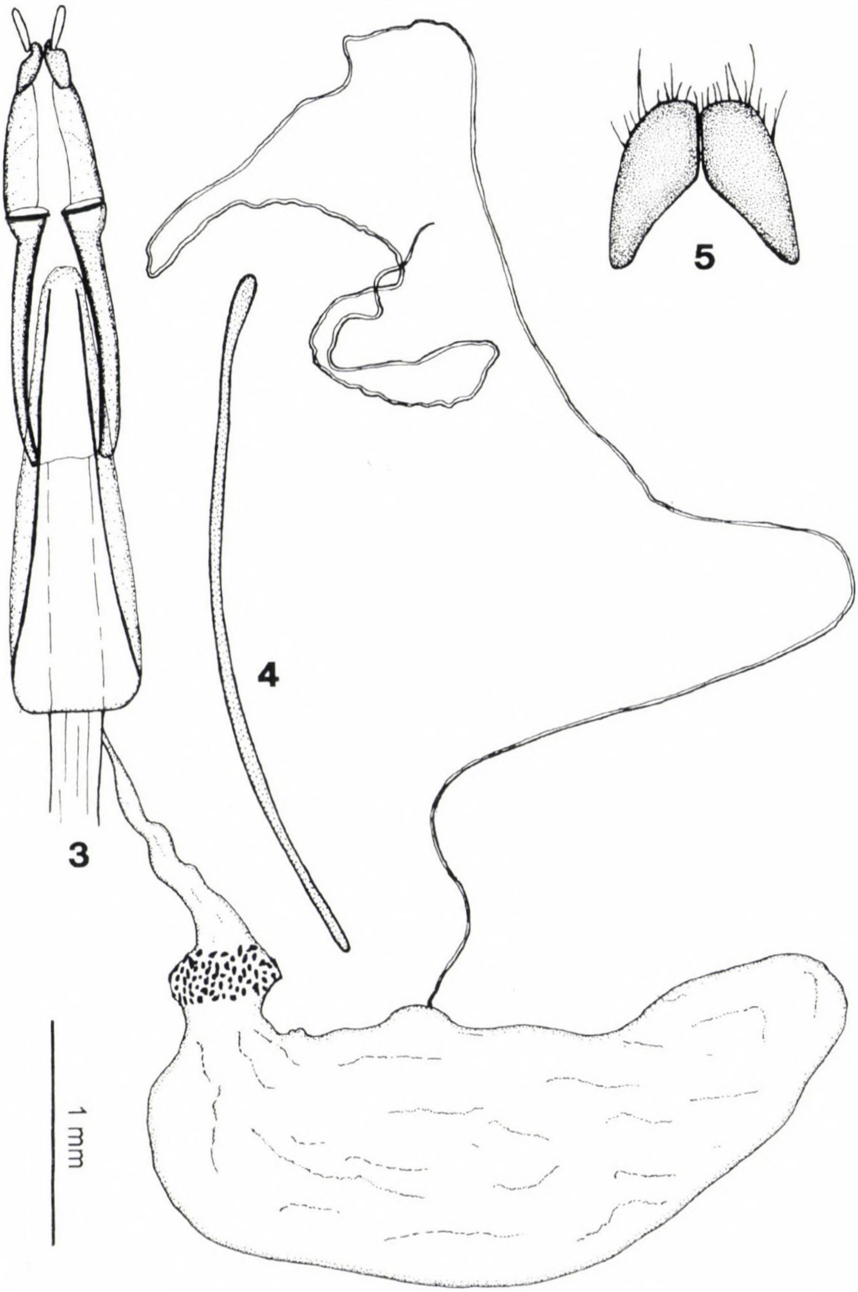
Female. Colour similar to male but head red with clypeus, labrum and a triangular spot on frons black. Antennal segment length ratios as 15 : 9 : 18 : 17 : 17 : 17 : 17 : 17 : 16 : 15 : 44. 8th abdominal tergite deeply notched at apex (Fig. 9).

Variability. The body length ranges from 9.5 to 12.3 mm. The variability in colour is somewhat sex-linked. The head of the males is always largely black, sometimes with a more or less distinct reddish postocular spot (as in the holotype). The head of females is red with black pattern as described above, the size of black frontal spot is variable and sometimes the spot is absent. The extension of the black area on the prothorax is also variable. Usually, the black area is restricted to the postcoxal region of prosternum but may extend to the precoxal region and the hypomeron and



Figs 1–2. Habitus of *Mimoborchmania*: 1 = *M. yangi* sp. n., 2 = *M. coloripes* (Pic)

Figs 3–5. *Mimoborchmania yangi* sp. n.: 3 = ovipositor and female genital tube, 4 = spiculum ventrale of female, 5 = 8th abdominal sternite of female



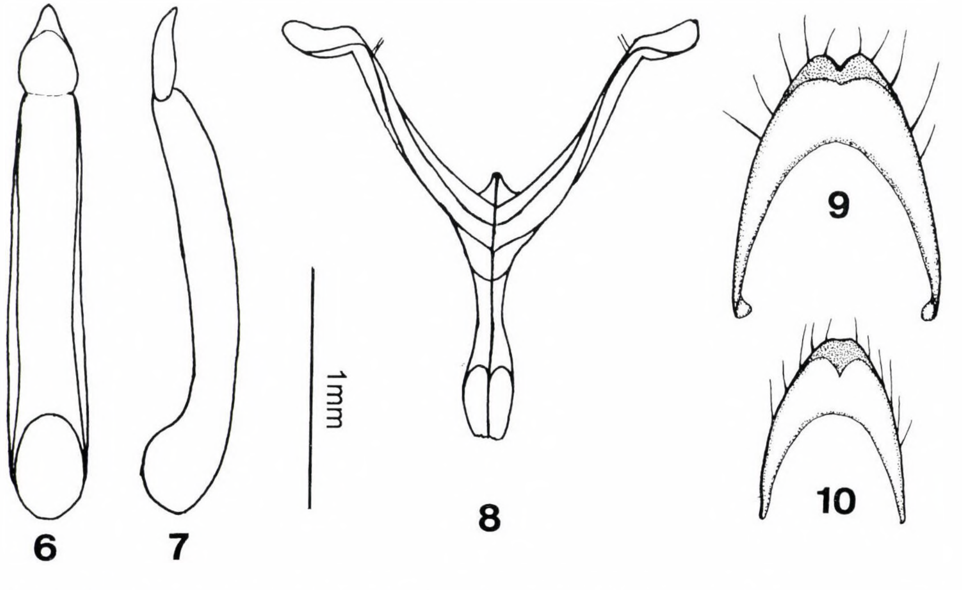
sometimes the whole ventral part of prothorax is black. In the three male paratypes from Yunnan the black area extends to nearly the entire prothorax and only the hind margin of pronotum remains red. The pterothorax (including the scutellum) and the abdomen are usually black. In four males, the pterothorax (including the scutellum) and the middle of the first visible abdominal sternite are red. Red pterothorax more frequently occurs in females and female abdominal sterna 1–3 may be entirely red. The yellow basal colouration of middle and hind tibiae is sometimes indistinct.

The frontal grooves may be deep to shallow. The fovea of vertex and the two rounded pits of pronotum may be large and deep or shallow to absent.

Etymology. The species is dedicated to Mr. YANG XINGKE, entomologist at IASB.

Remarks. *M. yangi* is the only species of the group of genera *Mimoborchmania, Borchmannia, Falsonemostira, Rouyerus* and *Pseudocasnonidea* which has completely impunctate pronotum. For diagnostic characters separating *M. yangi* from *M. coloripes*, see in the key to species.

Aposematically coloured, *M. yangi* is probably a member of a mimetic complex. Other beetles with similar body shape and red-and-black colour pattern occurring sympatrically with *M. yangi* include species of other Lagriini (*Casnonidea* FAIRMAIRE, 1882), Lycidae, Cerambycidae, Hispinae (Chrysomelidae). In order to reveal the lycid model, two specimens of *M. yangi* was sent to LADISLAV BOCÁK (Olomouc, Czech Republic) who compared them with many lycids collected in Chiang Mai (Thailand). He found (L. BOCÁK, pers. comm.) that the coloration is most similar to *Lyponia himalejica* BOURGEOIS, 1885. However, this lycid species is much larger and broader, inhabits the lowest level of humid



Figs 6–10. *Mimoborchmania yangi* sp. n.: 6 = aedeagus, ventral view, 7 = aedeagus, lateral view, 8 = metendosternite, 9 = 8th abdominal tergite of female; 10 = *Mimoborchmania coloripes* (PIC), 8th abdominal tergite of female

tropical forests (usually stream valleys and depressions of the karstic area) and is a rare beetle in that region. The representatives of other genera of Lycidae in Thailand are even more different in coloration. For example, species of *Lycostomus* MOTSCHULSKY, 1861 are darker and larger while species of *Cautires* C. O. WATERHOUSE, 1879 are largely yellow.

Checking other material collected in Thailand, Dr. L. BOCÁK has found specimens of an unidentified species of primitive Hispinae (without thorns on dorsal surface of the body) which are very similar to *M. yangi* both in colour pattern and subcylindrical body shape. Specimens belonging to one or two unidentified species of the cerambycid genus *Erythrus* WHITE, 1853, which are also from Chiang Mai and deposited in the HNHM, are also very much alike *M. yangi*. Various species of Hispinae are members of mimetic complexes in different parts of the world although their palatability is unknown to the authors. Many Cerambycidae are known to secrete odoriferous substances which serve as repellants and make them unpalatable (MOORE & BROWN 1971) and it is most probable that warning odour is widespread in the family. The Tenebrionidae, including Lagriini, are well-known to have abdominal glands which secrete defensive compounds, mainly quinones (BROWN *et al.* 1992). So, *Mimoborchmania*, *Casnonidea*, *Erythrus* and Hispinae with or without Lycidae may form a mimetic complex at least in North Thailand. If they are equally unpalatable, this complex might be an example of Müllerian mimicry but it is more probable that the members represent graded levels of the range of chemical defence between the Batesian and Müllerian extremes, similar to the case studied by MOORE & BROWN (1989).

Mimoborchmania coloripes (PIC, 1922)
(Figs 2, 10)

Nemostira coloripes PIC, 1922: 67; PIC 1934: 31 (footnote).
Nemostira coloripes var. *nigricolor* PIC, 1922: 67.
Nemostira bicoloripes [sic!] var. *nigrosuturalis* PIC, 1927: 28.
Nemostira bicoloripes [sic!] var. *seminigricolor* PIC, 1927: 28.
Mimoborchmannia [sic!] *coloripes*: BORCHMANN 1937: 490.

Material examined. LAOS: Northeastern Lao, Samneua, 26. V. 1992, Y. MIYAKE (2 ♂♂, 1 ♀, HNHM). VIETNAM: North Vietnam, Tam Dao N. P., 75 km NW Hanoi, 15. V. – 16. VI. 1991, E. JENDEK (1 ♂, 1 ♀, NHMW); Tonkin, Hoa Binh, VII. 1940, A. DE COOMAN (2 ♂♂, SWAU); Tonkin, Mt. Bavi, 800–1000 m, VII. 1941, A. DE COOMAN (3 ♂♂, SWAU).

Redescription. Length 7.5 to 9.1 mm. Head black with upper surface of mandibles red; antennae black with last 2–3 antennomeres sometimes reddish; pronotum red or black or red with variable black pattern; elytra red with black pattern (i. e. suture and/or apex black) or entirely black; pterothorax and abdominal sternites black or red; legs black with basal 1/6 of middle and hind femora and middle and hind tibiae yellowish. Habitus: Fig. 2.

Head length-to-width ratio as 1.3 : 1; surface coarsely and irregularly punctate, punctures smaller on clypeus and labrum; punctation sparser on clypeus, labrum and central part of vertex; temples without distinct impression behind eyes; antennal segment length ratios as 11 : 6 : 14 : 13 : 11 : 14 : 7 : 10 : 9: 8 : 42.

Prothorax length-to-width ratio as 1 : 1; pronotum convex, no distinct pits on sides of disc; disc with coarse punctures separated with interspaces of 2–5× puncture diameter; punctation sparses mesally and denser toward lateral portions; hypomeron and prosternum impunctate, with very fine transverse wrinkles. Mesosternum smooth mesally, sparsely punctate laterally. Mesepisternum and mesepimeron with scattered, coarse punctures. Metasternum smooth mesally, sparsely punctate laterally. Metepisternum sparsely punctate.

Elytra 1.6x wider than pronotum. Elytral epipleura impunctate, with very fine transverse wrinkles. Elytral interstriae with setigerous punctures as follows: interstria 1 with 4 (3 in basal 1/6, 1 in apical 1/10), interstria 3 with 4 (in apical 2/5), interstria 9 with one (in apical 1/10) puncture.

Abdominal sternites largely impunctate, lateral impressions with coarse and scattered punctures. Aedeagus similar to that of *M. yangi*.

Female. Antennal segment length ratios as 10 : 6 : 11 : 10 : 10 : 9 : 10 : 10 : 10 : 7 : 24. 8th abdominal tergite at most feebly emarginate at apex (Fig. 10).

Variability. The available material is too small to decide whether the colour variability is sex-linked or not. One specimen is completely black while in others red colour is dominant. All studied specimens have the dorsal cranial surface entirely black and never with red parts as in many specimens of *M. yangi*.

KEY TO SPECIES OF MIMOBORCHMANIA

– Head almost, pronotum completely impunctate; temples with shallow but distinct impression behind eyes; 8th abdominal tergite of female deeply notched at apex (Fig. 5); size larger (9.5–12.3 mm) (Fig. 1) **M. yangi** sp. n.

– Head and pronotum coarsely punctate; temples without distinct impression behind eyes; 8th abdominal tergite of female without apical notch (Fig. 10); size smaller (7.5–9.2 mm) (Fig. 2) *M. coloripes* (PIC, 1922)

* * *

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A TAXONOMIC STUDY ON THE GENUS ANARSIA ZELLER FROM THE MAINLAND OF CHINA (LEPIDOPTERA: GELECHIIDAE)

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In this paper, 17 species belonging to the genus *Anarsia* ZELLER are recognized from China. Of these, 7 species are described as new to science and 5 species are recorded for the first time from the mainland of China. The new species are: *A. beitunica* sp. n., *A. decora* sp. n., *A. eximia* sp. n., *A. largimacularis* sp. n., *A. magnibimaculata* sp. n., *A. novitricornis* sp. n. and A. *squamerecta* sp. n. The genital structures are illustrated.

Key words: Lepidoptera, Gelechiidae, *Anarsia*, new species, China

INTRODUCTION

More than 100 species of the genus *Anarsia* ZELLER, 1839 have been recorded worldwide, most of which are distributed in the Palaearctic, Oriental and Ethiopian regions. Several species have been reported to occur in the Australian and Neotropical regions. Only one species, *Anarsia lineatella* ZELLER, has been found in the Nearctic region, and this was introduced from Europe. Some species of *Anarsia* ZELLER are known to be serious pests. The known host plants include Papilionaceae, Rosaceae, Anacardiaceae, Rhamnaceae, Capparidaceae, Tamaricaceae, Loranthaceae, Salicaceae, Mimosaceae, Cistaceae and Elaeagnaceae. Some Asian species of the genus have recently been treated by PARK (1991, 1995), PONOMARENKO (1989), and PARK & PONOMARENKO (1996*a, b*). The present paper deals with the species of the genus from the mainland of China. A total of 17 species are listed, of which 7 species are new to science and 5 species are recorded for the first time from the mainland.

The type specimens are deposited in the Institute of Zoology, Shaanxi Normal University, Xi'an, China.

CHECKLIST OF ANARSIA ZELLER FROM THE MAINLAND OF CHINA

Anarsia euphorodes MEYRICK, 1922 – Distribution: China (Shanghai, Taiwan).
Anansia isogorca MEYRICK, 1913 – Distribution: China (Yunnan, Taiwan), Japan, India.
Anarsia tricornis MEYRICK, 1913 – Distribution: China (Jiangxi, Taiwan), Sri Lanka.

Anarsia elongata PARK, 1995 – Distribution: China (Shaanxi, Gansu, Taiwan). Material examined: 3 males and 2 females, Ningshan, Shaanxi Province, 880 m, 17–18.06.1987 (LI HOUHUN); 1 male, Kangxian, Gansu Province, 1200 m, 05.06.1995 (A. MAIMAITI).

Anarsia bipinnata (MEYRICK, 1932) – Distribution: China (new record), Japan, Korea, Russia. Material examined: 1 male, Yangling, Shaanxi Province, 450 m, 30.08.1985; 2 males, Chengcheng, Shaanxi Province, 1000 m, 30.08.1986; 2 males, Zhouzhi, Shaanxi Province, 1350 m, 15.07.1987; 1 male, Ningshan, Shaanxi Province, 880 m, 11.08.1987; 3 males, Fengxian, Shaanxi Province, 1600 m, 09–13.07.1988; 2 males and 3 females, Yuzhong, Gansu Province, 2120–2230 m, 29.07–04.08.1993 (all collected by LI HOUHUN). 1 male, Tianshui, Gansu, 09.08.1988 (WU XINGYU); 1 male and 1 female, Kangxian, Gansu Province, 800–1200 m, 05–06.06.1995 (A. MAIMAITI); 1 male and 4 females, Yuexi, Anhui Province, 02–18.07.1995 (HU XIANGFU).

Anarsia eleagnella KUZNETZOV, 1957 – Distribution: China (new record), Russia, Turkmenistan, Kazakhstan. Material examined: 1 male and 1 female, 19.05.1980, 8 males, 900 m, 29.08.1987, Urumqi, Xinjiang Uygur Autonomous Region (LI HOUHUN); 2 males and 1 female, Zepu, Xinjiang Uygur Autonomous Region, 1220 m, 02–22.08.1994 (A. MAIMAITI).

Anarsia lineatella ZELLER, 1839 – Distribution: China (Shaanxi, Xinjiang), Europe, North Africa, North America.

Anarsia patulella (WALKER, 1864) – Distribution: China (Shanghai, Jiangxi, Yunnan, Taiwan), India, Sri Lanka, Australia.

Anarsia protensa PARK, 1995 – Distribution: China (Jiangxi, Anhui, Taiwan). Material examined: 1 male, Changguling, Jiangxi Province, 24.06.1978; 1 male, Yifeng, Jiangxi Province, 01.07.1980; 1 male, Yuexi, Anhui Province, 08.08.1995 (HU XIANGFU).

Anarsia spartiella (SCHRANK, 1802) – Distribution: China (new record), Europe, Asia Minor, Russia, Mongolia. Material examined: 3 females, Zhongning, Ningxia Hui Autonomous Region, 1985–1987 (SUN HONGYI)

Anarsia beitunica sp. n. – Distribution: China (Xinjiang).

Anarsia decora sp. n. – Distribution: China (Yunnan).

Anarsia eximia sp. n. – Distribution: China (Shaanxi).

Anarsia largimacularis sp. n. – Distribution: China (Shaanxi).

Anarsia magnibimaculata sp. n. – Distribution: China (Shaanxi).

Anarsia novitricornis sp. n. – Distribution: China (Jiangxi).

Anarsia squamerecta sp. n. – Distribution: China (Shaanxi).

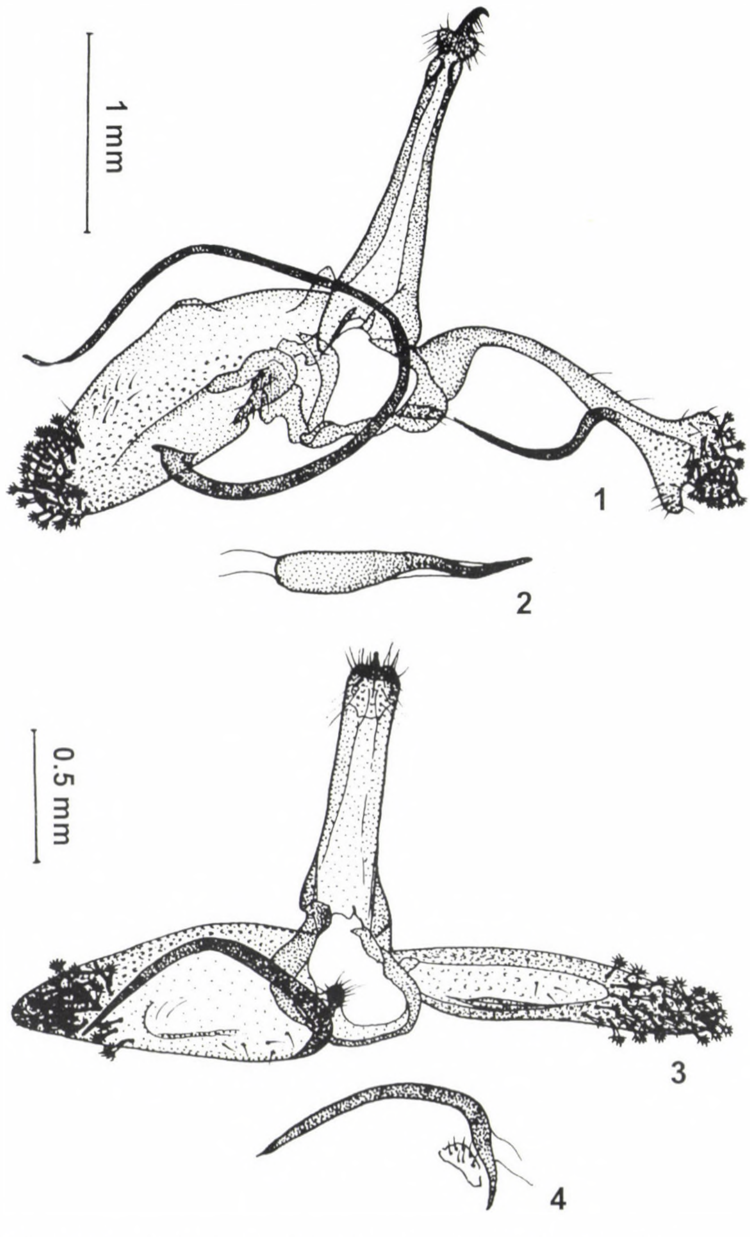
THE DESCRIPTIONS OF THE NEW SPECIES

Anarsia beitunica sp. n.
(Figs 1, 2, 17)

Diagnosis. The new species resembles *Anarsia bimaculata* PONOMARENKO, 1989, but can be distinguished from it by the ventral process of the left valva which is twice as long as the valva itself, the long and medially narrow right valva in the male genitalia, and different forewing markings.

Holotype: male, Beitun, Xinjiang Autonomous Region, 530m, 20.07.1994 (LI HOUHUN), genitalia slide no. L95260.

Description. Male wingspan 14.0 mm. Head greyish white, middle with longitudinally arranged brown scales. Labial palpus brown on outer surface, inner surface greyish brown; second segment with long dense scale tuft, somewhat oblong, greyish white distally. Antenna greyish white ventrally, brown ringed grey dorsally. Thorax greyish white, with mottled brown scales. Tegula brown, with a few greyish white scales. Forewing brown, mixed with greyish white scales and



Figs 1–4. Male genitalia: 1, 2 = *Anarsia beitunica* sp. n.; 3, 4 = *A. decora* sp. n.

erect black scales, basal half mainly greyish white, costal margin with short black brown streaks oblique to outside; cell with rhomboidal dark brown spot medially. round spot, just beyond posterior margin of cell, surrounding areas and middle greyish white; small white dot at 1/2 and 2/3 of fold respectively; cilia greyish white, mixed with black; ventral surface without long hairpencil. Hindwing and cilia grey. Legs brown, with scattered white scales, tibiae and tarsi with white rings, hind tibia pale brown, clothed with long hairs.

Male genitalia (Figs 1, 2): Uncus small, narrow anteriorly, posterior margin with long curved median process at middle, longer than uncus in length, hairy. Tegumen long and narrow, gradually widening toward base, shorter than valvae. Valvae asymmetrical: left valva long elliptical, ventrally with hairy membranous process at base, a slender curved sclerotized process arising from middle of sacculus, its length twice as long as the valva itself; right valva long and narrow, wide basally, strongly curved at 1/4, distal 1/4 expanded, nearly quadrate, ventrally with short wide hairy process, a slender, curved sclerotized process at 3/4 ventrally, about half length of valva, pointed distally; several palmate scales grouped at distal end of valvae. Aedeagus slender, distal half long and narrow, curved, distally pointed.

Female: Unknown.

Distribution: China (Xinjiang).

Anarsia decora sp. n.
(Figs 3, 4, 18)

Diagnosis. This species is closely allied to both *Anarsia acerata* MEYRICK, 1913 and *Anarsia lechriosena* BRADLEY. It differs from them by the distinct forewing markings; the ventral process of the left valva being nearly as long as the valva itself and the strongly curved aedeagus in the male genitalia.

Holotype: male, Mengla, Yunnan Province, 630 m, 21.11.1987 (LI HOUHUN), genitalia slide no. L95474.

Description. Male wingspan 10.0 mm. Head greyish brown, frons with brown scales laterally. Labial palpus black brown on outer surface, second segment greyish white distally and on inner surface. Antenna greyish brown. Thorax greyish brown, brown laterally. Tegula greyish brown, with scattered brown scales. Forewing greyish white, mixed with black scales; costal margin with short streaks, a long blotch in middle; irregular black blotch at middle of cell and on fold at 1/2 respectively; indistinct stripe at middle of posterior margin; indistinct black blotch edged with scattered black scales between end of cell and apex; cilia greyish vhite; ventral surface without hairpencil. Hindwing and cilia grey, apical angle acute, termen not concave. Legs brown.

Male genitalia (Figs 3, 4): Uncus as wide as tegumen, setose, concave apically; median process small, distally pointed. Tegumen long and narrow, lateral margins parallel, slightly broad at base. Valvae asymmetrical: left valva broad, gradually narrowed distally, apex blunt, densely set with palmate scales; slender, medially curved process at base of sacculus, nearly as long as valva, distally pointed; right valva long and narrow, both margins nearly parallel, gradually narrowed toward apex, bearing palmate scales. Vinculum narrow cestiform. Aedeagus slender, strongly curved, acute distally.

Female: Unknown.

Distribution: China (Yunnan).

Anarsia eximia sp. n.
(Figs 5, 6, 19)

Diagnosis. *A. eximia* is closely allied to most species of the genus in appearance, and has two spots on the forewing. However, the male genitalia are very distinct: (1) uncus anteriorly with a pointed process; (2) socius well-developed; (3) transtilla developed.

Holotype: male, Foping, Shaanxi Province, 1070 m, 24.07.1985 (LI HOUHUN), genitalia slide no. L95244.

Description. Male wingspan 14.0 mm. Head greyish white. Labial palpus with outer surface dark brown, second segment with triangular scale tuft on ventral surface, distal and inner edge greyish white. Antenna greyish white ventrally, dorsally brown, with greyish white rings. Thorax and tegula greyish brown, tegula dark brown basally. Forewing with costal margin slightly concave at middle; ground colour greyish brown, mottled brown scales; costal margin with indistinct short oblique lines, medially with semicircular black blotch; cell at middle with obliquely oblong black blotch; cilia greyish brown; ventral surface with long hairpencil near base, Hindwing and cilia grey. Fore- and midlegs dark brown, tarsi with pale rings; hindleg pale brown, with scattered brown scales ventrally, spur brown.

Male genitalia (Figs 5, 6): Uncus triangular, with hairy process on anterior margin, apex acute, slightly curved; posterior margin wide, straight; socius large, kidney-shaped, with long hairs. Tegumen long and narrow, slightly narrower at basal 1/3, wider at 2/3. Valvae asymmetrical: left valva large and broad, costa archedly convex, narrowly rounded distally, densely set with palmate scales, sacculus considerably broader at middle, a short curved process at 1/3, a strong curved process at 2/3, pointed distally; right valva wide at base, narrowed distally, apically with dense palmate scales, sacculus with large process at 1/3, round, setose. Transtilla developed, stout, 1/2 length of valva. Aedeagus small, distal half thin and pointed.

Female: Unknown.

Distribution: China (Shaanxi).

Anarsia largimacularis sp. n.
(Figs 7, 8, 20)

Diagnosis. *A. largimacularis* is closely allied to *Anarsia tricornis* MEYRICK, 1913 in appearance. It differs from the latter by the nearly symmetrical valvae and the lack of a process on the sacculus in the male genitalia.

Holotype: male, Fengxian, Shaanxi Province, 1600 m, 09.07.1988 (LI HOUHUN), genitalia slide no. 89158.

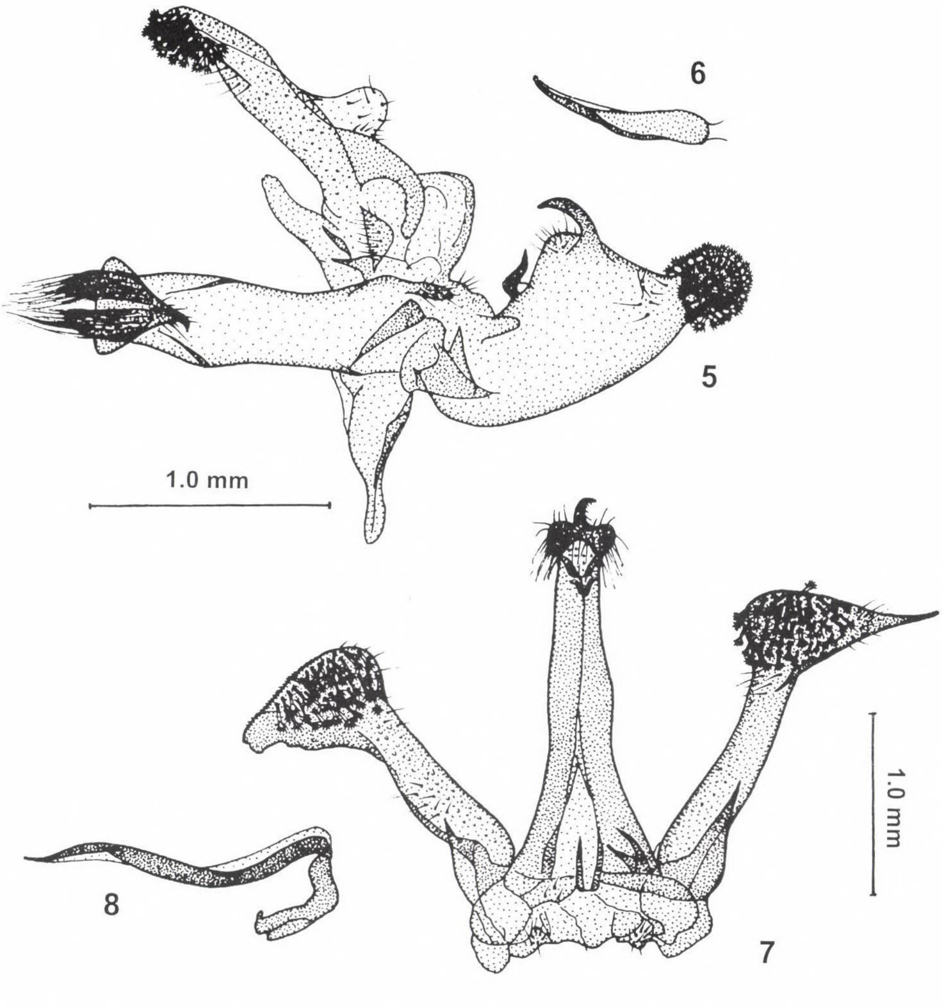
Description. Wingspan 18.5 mm. Head greyish brown, frons with brown scales laterally. Labial palpus brown on outer surface, inner surface white; second segment with triangular scale tuft on ventral surface. Antenna greyish white, flagellum with brown rings dorsally. Thorax greyish white, mixed with brown scales. Tegula black at base, greyish white distally. Forewing with costal and posterior margins nearly parallel, somewhat concave at middle, apex bluntly acute; ground colour greyish brown, with scattered brown scales, especially on apex; costal margin with indistinct short streaks, medially with large triangular black blotch extending to middle of wing, outer edge

concave; cilia grey, ventral surface with long hairpencil near base. Foreleg brown, tarsus with pale rings; midleg brown, tibia basally greyish white, tarsus with white rings; hindleg light brown, tibia densely covered with greyish white hairs dorsally.

Male genitalia (Figs 7, 8): Uncus short, hairy, wider than apex of tegumen, anterior margin deeply concave, posterior margin slightly concave. Tegumen long and narrow, basal portion two times wider than distal portion. Valvae nearly symmetrical: left valva long and narrow, costa straight, sacculus somewhat convex, apex expanded, dorsally convex, bluntly triangular ventrally, with dense palmate scales; right valva long, narrow, margins nearly parallel, slightly wider at base, somewhat bent at middle, dilated distally, rounded at apex, ventrally extended to sharp point, bearing dense palmate scales. Aedeagus slender, S-shaped, pointed distally.

Female: Unknown.

Distribution: China (Shaanxi).



Figs 5–8. Male genitalia: 5, 6 = *Anarsia eximia* sp. n.; 7, 8 = *A. largimacularis* sp. n.

Anarsia magnibimaculata sp. n.
(Figs 9, 10, 21)

Diagnosis. The new species resembles *Anarsia bimaculata* PONOMARENKO, 1989 in appearance, but can be easily separated from it by the following characters: markings on the forewing not truncate and with distinct black dots near its base; right sacculus in the male genitalia with distal process outwardly curved and basal process not pronounced.

Holotype: male, Zhouzhi, Shaanxi Province, 1750 m, 20.07.1987 (LI HOUHUN), genitalia slide no. L95238.

Description. Wingspan 17.5 mm. Head greyish brown, with scattered dark brown scales. Labial palpus dark brown on outer surface, inner surface greyish white to brown; second segment greyish white distally, with dense oblong scale tuft on ventral surface. Antenna greyish white, ringed brown, scape greyish white, mottled brown dorsally. Thorax and tegula greyish brown, mixed with brown. Costal margin of forewing somewhat concave at middle, apical angle obtusely pointed; ground colour greyish brown, with many greyish white and some black scales; costal margin with several oblique streaks, base black, an oblong black blotch at middle, below this a further oblong black blotch in middle of cell; clear small black dot near base, several small dots formed by erect black scales from end of cell to apex, scattered with brown scales; cilia greyish brown, mixed brown; long hairpencil near base ventrally. Hindwing and cilia greyish brown. Fore- and midlegs fuscous, tarsus with white rings; tibia of midleg greyish white at base; hindleg blackish brown, distally white; tibia brown ventrally, dorsally greyish white, with dense long hairs, tarsus brown ringed greyish white.

Male genitalia (Figs 9, 10): Uncus long and narrow, densely covered with long setae, anterior margin straight, posterior margin nearly round, with strong acute distal process at middle, shorter than uncus. Tegumen long, narrow, slightly broader at base. Valvae asymmetrical: left valva large and broad, nearly elliptical, costa membranous, palmate scales near apex; basal process of sacculus strong, slender, pointed distally, longer than valva; right valva long and narrow, slightly wider at base, narrow at middle, somewhat curved, costa roundly protruding near apex, apically with palmate scales, a large process curved outwardly, setose, sacculus with slender process at 2/3, as long as 2/3 of valva, pointed at distal. Vinculum narrow, bearing short process medially. Aedeagus with basal half cylindrate, distal half gradually narrowed and curved.

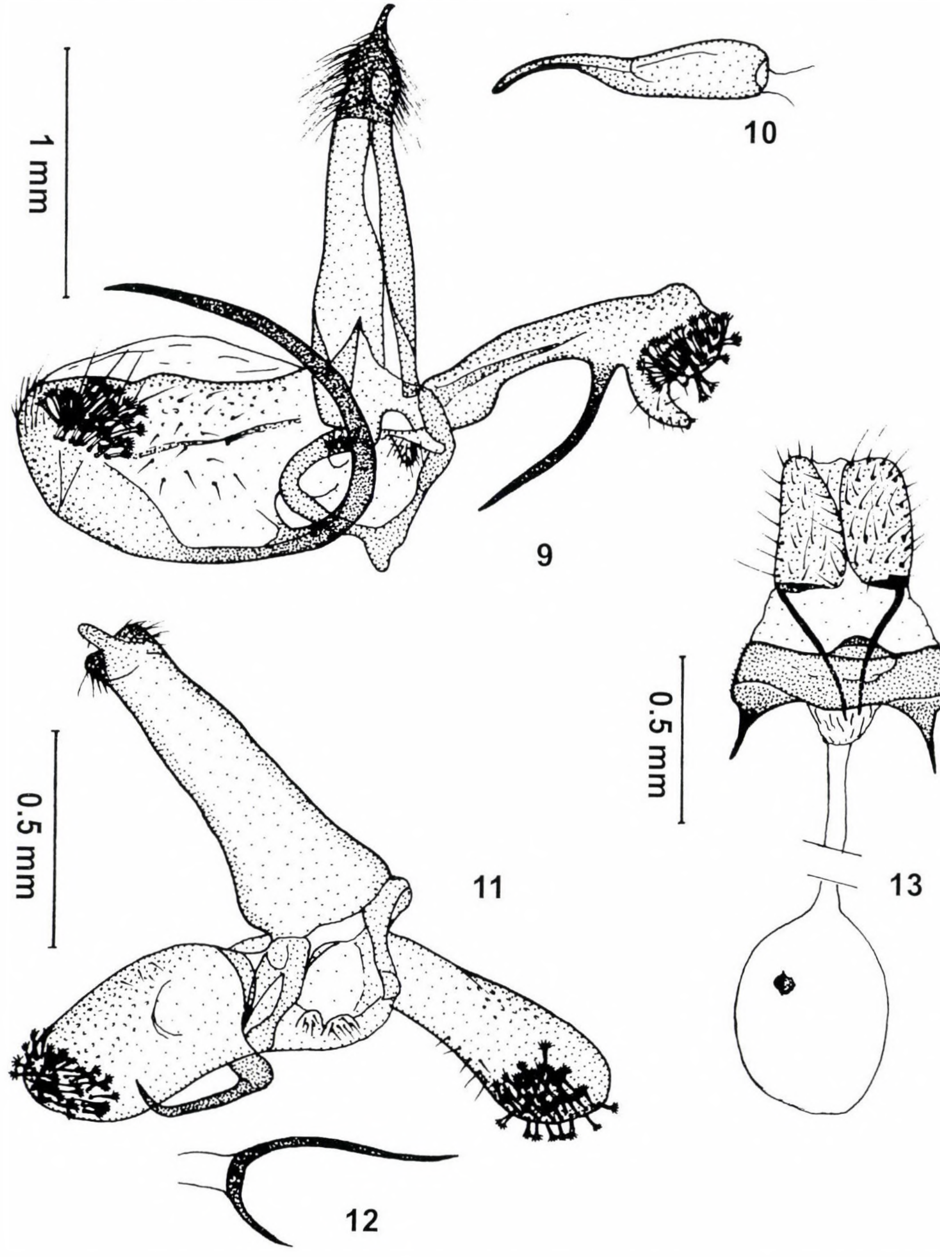
Female: Unknown.

Distribution: China (Shaanxi).

Anarsia novitricornis sp. n.
(Figs 11–13, 22)

Diagnosis. Superficially, this species resembles to *Anarsia tricornis* MEYRICK, 1913. It differs from the latter by the forewing having a triangular blotch at the middle of the costal margin not reaching beyond the fold; basal process of left sacculus strong, right valva with distal half round and sacculus nearly straight in the male genitalia; signum in the female genitalia cap-like.

Holotype: male, Tonggu, Jiangxi Province, 27.07.1982, genitalia slide no. L95252. Allotype: female, Nanchang, Jiangxi Province, 23.07.1983, genitalia slide no. L95197. Paratypes: 2 males, same locality as allotype, 21–25.07.1983.



Figs 9–13. Genitalia: 9, 10 = male of *Anarsia magnibimaculata* sp. n.; 1113 *A. novitricornis* sp. n.: 11, 12 = male, 13 = female

Description. Wingspan 9.5-10.0 mm. Head greyish white, around eyes blackish brown. Labial palpus with outer surface black, inner surface greyish white; second segment greyish white distally, scale tuft on ventral surface quadrate. Antenna greyish white ringed brown. Thorax brown, mixed with greyish white. Tegula brown, distal greyish white. Forewing greyish white to greyish brown, with scattered brown scales; costal margin with indistinct short streaks, a black triangular blotch at middle of costa reaching middle of cell, not beyond fold; between fold and posterior margin as well on apex densely with brown scales; cilia greyish brown, mottled-brown scales; ventral surface without long hairpencil. Fore- and midlegs brown on inner surface, outer surface greyish white; tarsus ringed white; midleg with tibia greyish white basally; hindleg brown, tibia clothed with long pale hairs.

Male genitalia (Figs 11, 12): Uncus short, nearly as long as tegumen, somewhat concave on posterior margin, with hairs laterally, median process large, longer than uncus, blunt distally. Tegumen long and narrow, wider at base. Valvae asymmetrical: left valva wide, elliptical, bearing palmate scales at apex; sacculus near base with a strong process suddenly curved at basal 1/5, then slowly thinned to distal 1/5, curved and distally pointed; right valva long and narrow, gradually widened from base to apex, rounded apically, with palmate scales. Vinculum cestiform. Juxta being a pair of membranous lobes. Aedeagus slender, strongly curved at base, somewhat hooked, pointed distally.

Female genitalia (Fig. 13): Papillae analis large and wide, densely setose. Anterior apophyses wide at base, about 1/3 length of posterior margin. Eighth abdomere wide and short, slightly concave on posterior margin, medially with a projection. Ostium membranous, infundibulate. Ductus bursae slender. Corpus bursae elliptical, with one small signum.

Distribution: China (Jiangxi).

Anarsia squamerecta sp. n.
(Figs 14-16, 23)

Diagnosis. This species is similar to *Anarsia halimodendri* CHRISTOPH, 1877, but can be readily distinguished from the latter by the genital characters of both sexes: in the male the process near the base of the left sacculus is much longer than the valva and right valva has no process near the base of the sacculus; in the female the anterior apophyses are wide and distally blunt.

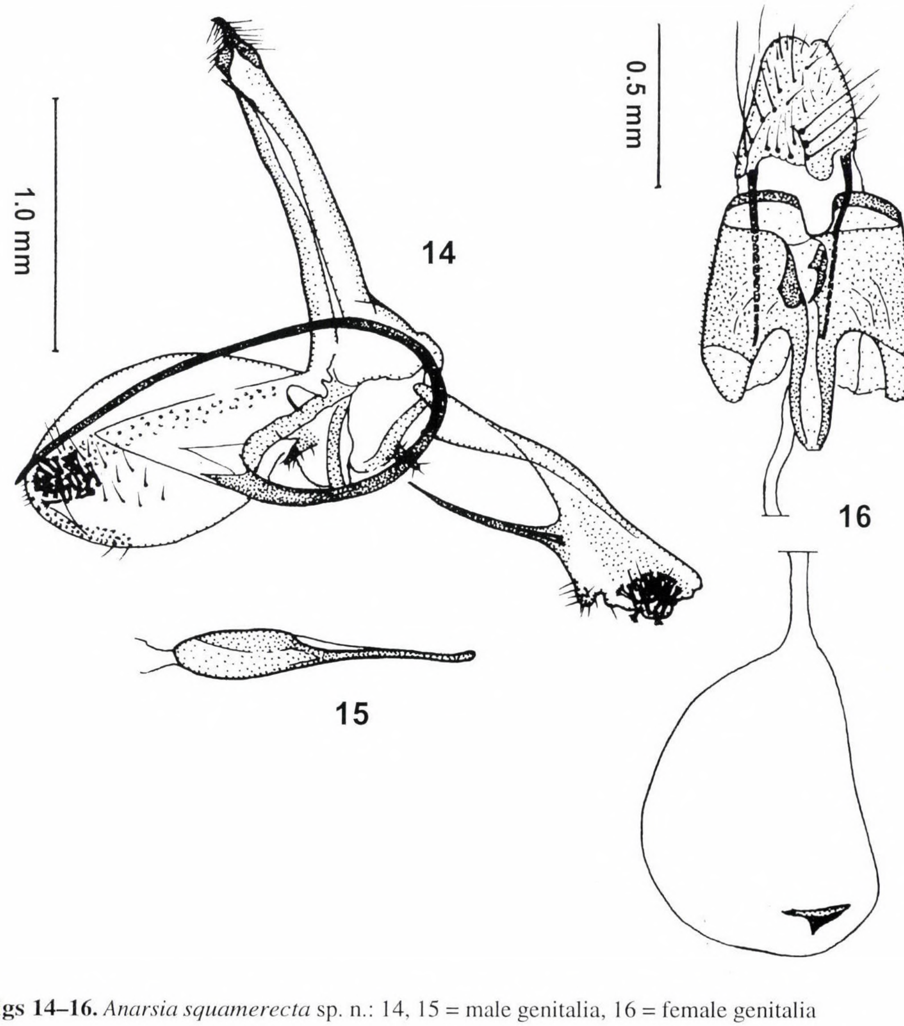
Holotype: male. Yangling. Shaanxi Province, 13.05.1986 (LI HOUHUN), genitalia slide no. L95469. Allotype: female, 27.05.1985, same locality and collector as holotype, genitalia slide no. L95205. Paratypes: 8 males and 10 females, 26.05–20.06.1985, same data as holotype.

Description. Wingspan 11.5–13.0 mm. Head brown, frons greyish white. Labial palpus brown, with scattered greyish white scales, inner surface greyish brown; second segment with oblong scale tuft on ventral surface; third segment in female brown at base and middle, greyish brown at 1/3, and apex. Thorax and tegula brown, mixed with several greyish white scales. Forewing with costal margin somewhat convex at base, slightly concave at middle, posterior margin straight, apex blunt; ground colour brown, mixed with grey, densely erect black scales becoming blotch; costal margin with short black streaks, a semicircular black blotch set at middle; near base with black spot, cell with dispersed black scales, forming obscurely edged large black blotch extending backward to end of fold; two black scale tufts between fold and posterior margin; apex with more black scales; cilia greyish brown, mixed with brown scales; male with long hairpencil near base ventrally. Basal half of hindwing greyish white, distal half greyish brown; cilia greyish brown. Fore- and midlegs dark brown, tibiae and tarsi with white rings. Hindleg brown, femur greyish white distally,

tibia densely covered with long greyish white hairs, spur black brown, greyish white distally; tarsus fuscous ringed white.

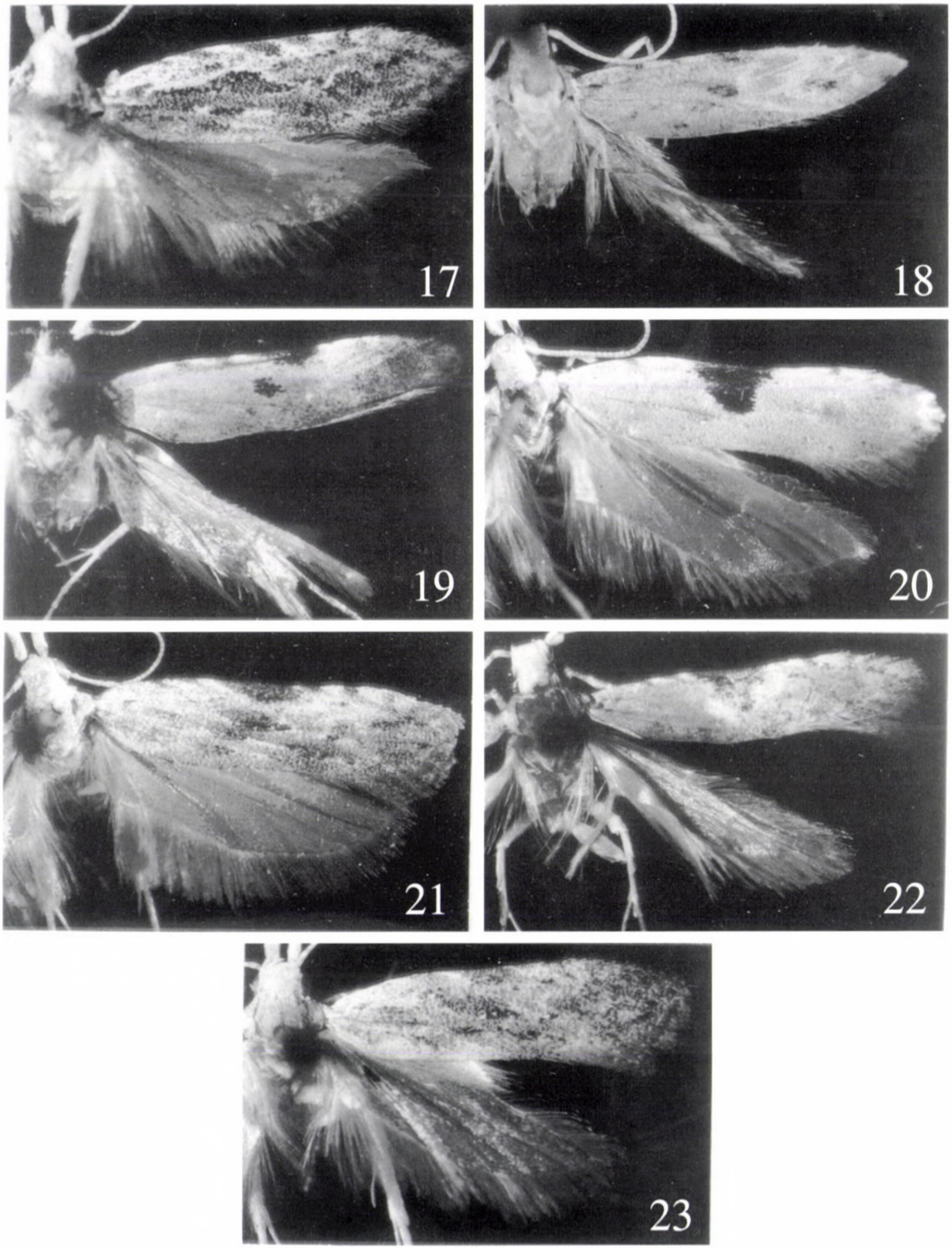
Male genitalia (Figs 14, 15): Uncus narrow, nearly as wide as end of tegumen, anterior margin deeply concave at middle, caudal margin projecting at middle, almost same length as uncus, distally curved and acute, with setae on both sides. Tegumen long and narrow, both margins nearly parallel, wide at base. Valvae asymmetrical: left valva elliptical, apex with palmate scales; sacculus with slender, sclerotized process arising from near base, strongly curved, much longer than valva; right valva narrow in basal half, distal half wide, with irregular processes at apex, bearing palmate scales; sacculus with hairy process at apex, a slender process coming from 2/3, about half length of valva, acute distally. Aedeagus with basal 2/5 stout, distal 3/5 slender.

Female genitalia (Fig. 16): Papilla analis short and broad, with long setae. Eighth tergum sclerotized posteriorly, deeply cut at middle. Ostium sclerotized, shaped irregularly. Eighth sternum anteriorly protruding forward at middle, protruding part tubulose, distal gradually narrowed, more than half length of posterior apophyses. Anterior apophyses much wide, less than half length of



Figs 14–16. *Anarsia squamerecta* sp. n.: 14, 15 = male genitalia, 16 = female genitalia

Figs 17–23. Adults of *Anarsia* spp.: 17 = *A. beitunica* sp. n., 18 = *A. decora* sp. n., 19 = *A. eximia* sp. n., 20 = *A. largimacularis* sp. n., 21 = *A. magnibimaculata* sp. n., 22 = *A. novitricornis* sp. n., 23 = *A. squamerecta* sp. n.



posterior apophyses. Ductus bursae long and narrow. Corpus bursae nearly round; signum dentate, at bottom of corpus bursae.

Distribution: China (Shaanxi).

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SIX NEW SPECIES OF NOCTUIDAE (LEPIDOPTERA) FROM ASIA

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Descriptions of six new Noctuidae species, *Chamyla salki* sp. n. (China), *Chamyla metaleuca* sp. n. (China), *Brachygalea leptographa* sp. n. (Turkmenistan, Kazakhstan), *Agrochola azerica* sp. n. (Azerbaijan), *Pseudohadena* (s. l.) *nobilis* sp. n. (China) and *Euchalcia aureolineata* sp. n. (Syria) are given. With 34 figures.

Key words: Noctuidae, new species, Asia

INTRODUCTION

The intensity of the faunistic exploration of some formerly less investigated areas has considerably increased in the last ten years. This has resulted in vast collections of material from the Asiatic part of the former Soviet Union, and also in a few, but from taxonomic and biogeographical points of view very interesting, specimens have been collected in different parts of China. The taxonomic elaboration of these new materials is still in its early phase but the discovery of a large number of new taxa among them can be predicted.

The present paper is the second contribution of the series dealing with the new taxa preserved in large private collections in Hungary and/or discovered by Hungarian lepidopterological expeditions (the first part was published by VARGA & RONKAY, 1991).

The holotypes, deposited in coll. P. GYULAI and coll. G. RONKAY are available for study through the Hungarian Natural History Museum, Budapest.

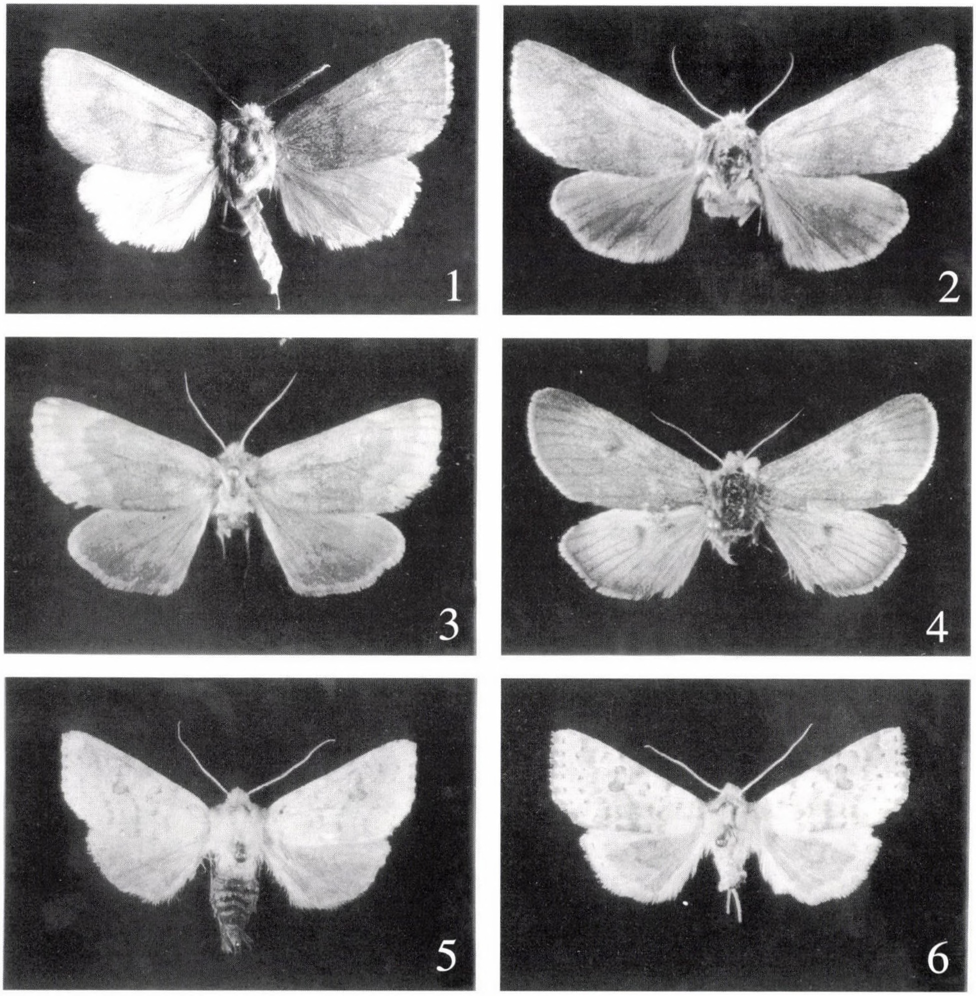
Chamyla salki sp.n.
(Figs 1, 2, 11–13)

Holotype: Male, China, Gansu, Jiayuguan, 100 km S Jingtieshan, 4100 m, 22–25.07.1993, leg. ANDREE SALK, deposited in coll. P. GYULAI (Miskolc, Hungary), slide No. 707 GYULAI.

Paratype: female, China, Gansu, Quiliansan, Jiayuguan, 100 km Jingtieshan, 3600–4100 m, 22–25.07.1993, leg. ULRICH SALK, deposited in coll. G. RONKAY (Budapest, Hungary). Slide No. 5819 RONKAY.

Taxonomic notes: The genus belongs, together with its close relatives, *Isochlora* STAUDINGER, 1882 and *Grumia* ALPHERAKY, 1892, to the subfamily Heliothinae, due to the presence of spines on their mid- and hind tibiae, although the armature of spines is strongly variable within these genera. Unfortunately this generic group has not been taken into consideration in the recently published monographic work on the subfamily (MATTHEWS 1991).

The male genitalia of the genus-group show a rather homogeneous structure (see BOURSIN 1963, those of the species of *Chamyla* STAUDINGER, [1900]1899 have not been published yet). The ground plan of the female genitalia is very uni-



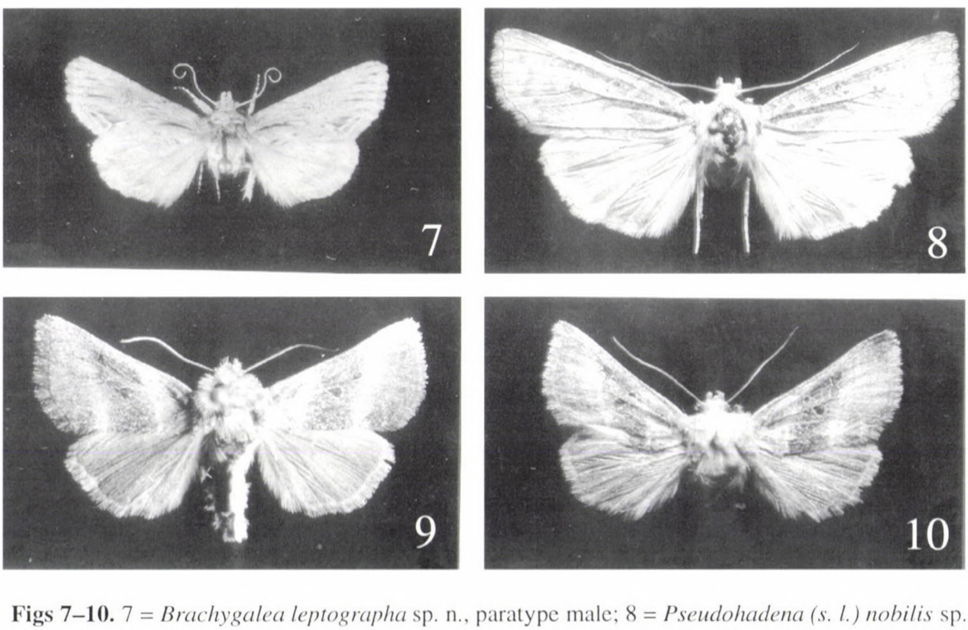
Figs 1–6. 1 = *Chamyla salki* sp. n., holotype male; 2 = *Ch. salki* sp. n., paratype female; 3 = *Ch. intricans* ALPHERAKY, female, Kuruk-Tash; 4 = *Ch. metaleuca* sp. n., holotype female; 5 = *Agrochola azerica* sp. n., holotype male; 6 = *A. azerica* sp. n., paratype male

form within the genus, characterized by the long, conical, sclerotized ovipositor, lacking almost all sensory setae, the weakly sclerotized ostium bursae, the tubular, wrinkled and scobinate ductus bursae and the small, membranous corpus bursae with wrinkled, conical or elliptical cervix bursae.

Diagnosis: The new species differs from the related *C. affinis* DRAUDT, 1935, *C. vecors* PÜNGELER, 1904 and *C. intricans* ALPHERAKY, 1882, by its greenish grey ground colour, the complete lack of the stigmata and the dark veins, from the more or less greenish-grey *C. arctomys* ALPHERAKY, 1897, by the diffuse, less sinuous ante- and postmedial crosslines and the lack of the subterminal.

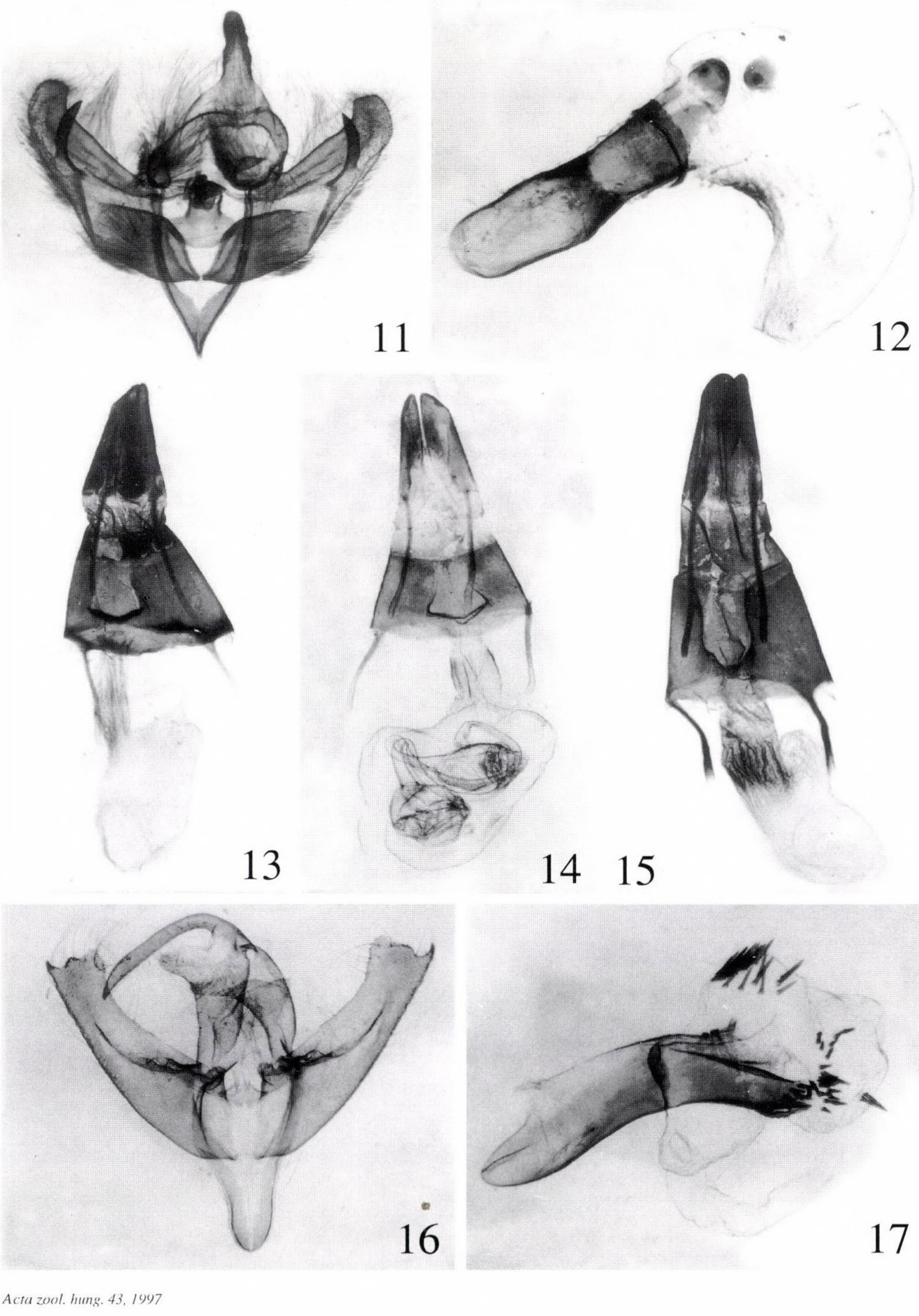
The female genitalia of *C. salki* differ from those of *C. intricans* by their stronger, more sclerotized ostial ring, significantly longer, more wrinkled but less sclerotized ductus bursae, larger cervix and the complete lack of the signa (*intricans* has three short, more or less ribbon-like signum-patches).

Description: Wingspan 31–37 mm, length of forewing 16–19 mm. Head and thorax olive-greyish mixed with whitish and mouse-grey hairs. Palpi short, slender, porrect, antenna dark blackish grey, strongly bipectinate (male) or very finely serrate (female). Forewing elongate, narrow with apex pointed, outer margin finely concave below apex. Ground colour dark olive-grey with variably strong dark green irroration, especially in basal and marginal fields. Wing pattern very indistinct, ante- and postmedial crosslines diffuse, slightly sinuous, darker grey, stigmata and subterminal absent; veins covered by darker grey scales. Terminal line blackish-grey, more or less distinct, cilia brownish grey. Hindwing brownish grey, veins darker grey, transverse line and discal



Figs 7–10. 7 = *Brachygalea leptographa* sp. n., paratype male; 8 = *Pseudohadena (s. l.) nobilis* sp. n., holotype male; 9 = *Euchalcia aureolineata* sp. n., holotype male; 10 = *E. aureolineata*, paratype male

Figs 11–17. 11–12 = *Chamyla salki* sp. n., male genitalia, holotype; 13 = *Ch. salki* sp. n., female genitalia, paratype; 14 = *Ch. intricans* ALPHERAKY, female genitalia; 15 = *Ch. metaleuca* sp. n., female genitalia, holotype; 16–17 = *Brachygalea leptographa* sp. n., male genitalia, paratype



spot present but diffuse, poorly visible. Terminal line dark grey-brown, cilia pale ochreous grey. Underside of wings pale whitish-greyish, hind wing somewhat lighter, more ochreous-whitish, inner area of forewing, traces of discal spots and transverse lines diffuse.

Male genitalia (Figs 11–12): Uncus short, rather thick, heavily sclerotized, apically finely hooked. Tegumen low, wide, penicular lobes well-developed, rounded, densely setose. Fultura inferior relatively large, strong, subdeltoidal with truncated apex, vinculum sclerotized, acute, V-shaped. Valva relatively short, apically tapering, cucullus rounded, with a fine peak at costal part; corona missing. Sacculus short, strong, clavus absent. Harpe situated distally, basal plate long, strong, erected part sclerotized, rather long, apically flattened, rounded. Aedeagus cylindrical, relatively short, carina with two short, wedge-shaped bars. Vesica short but wide, recurved laterally, basal part with two wide-based, rounded, finely peaked cornuti, one of them triple-peaked, partly fused with carina. Inner curve of vesica with a sclerotized, wrinkled ribbon, posterior third covered with minute spiculi.

Female genitalia (Fig. 13): Ovipositor strong, long, conical, papillae anales only very scarcely setose; gonapophyses strong, moderately long. Ostium bursae calyculate, membranous with fine wrinkles and narrow, sclerotized, arcuate ribbon at ventral edge. Ductus bursae rather long, tubular, membranous with strong longitudinal wrinkles and fine scobination. Cervix bursae small, slightly conical, membranous with fine wrinkles, ductus seminalis relatively broad. Corpus bursae ovoid, weakly membranous, without signa.

Bionomics and distribution: The two known specimens of the species were found in the same area north from the Kuku-Noor region (China, Prov. Gansu). The moths were collected in the subalpine zone, in the midsummer period, no information is given about their activity period.

Etymology: The new species is named in honour of the SALK family (Berlin), the collectors of the two known specimens of the taxon.

Chamyla metaleuca sp. n.
(Figs 4, 15)

Holotype: female, Tibet, Damxun, Larghe-La, 5200 m, 2–6.VII.1996, leg. WILLY FICKLER (deposited in coll. P. GYULAI). Slide No. 5808 RONKAY.

Diagnosis: The new species differs from all known members of the genus by its whitish hindwings with sharply defined discal spot, the presence of the orbicular and reniform stigmata of the forewing and the whitish underside of both wings with well-discernible discal spots. The female genitalia differ from those of *C. intricans* by its longer, more conical ovipositor, narrower ostium bursae opened with a longer, narrower incision, significantly longer, more wrinkled ductus bursae, larger cervix and the complete lack of the signa (*C. intricans* has three short, more or less ribbon-like signum-patches), from *C. salki* by its somewhat longer, apically more rounded ovipositor, the smaller ostium bursae without sclerotized ventral ring, the shorter but broader ductus bursae with stronger wrinkles at medial third and the larger, elliptical, scobinate cervix bursae.

Description: Wingspan 37 mm, length of forewing 17 mm. Head and collar orange-yellowish, thorax, tegulae and abdomen dark brownish-grey; antennae filiform, short. Forewing relatively narrow with apex rounded, outer margin evenly arcuate. Ground colour dark fumous grey, darkest

at apical part and at inner margin; irrorate scarcely with pale ochreous, mostly in cell and along costa. Ante- and postmedial crosslines obsolete, represented by very indistinct, dark grey shadows, streak of submedian fold long, fine dark grey; veins covered with darker grey. Orbicular and reniform stigmata present as rather diffuse, blackish grey spots, former small, flattened, latter large, more or less lunulate. Subterminal missing. Cilia whitish with broad, dark grey inner stripe. Hind wing whitish, irrorate with a few greyish scales, veins covered with blackish grey. Discal spot strong, lunulate, transverse line absent, marginal suffusion narrow, dark brownish grey. Terminal line blackish grey, cilia whitish. Underside of both wings ochreous-white with narrow, blackish grey marginal area, discal spots strong, blackish, forewing with long blackish stripe at submedian fold.

Female genitalia (Fig. 15): Ovipositor strong, long, conical with rounded tip, papillae anales only very scarcely setose; gonapophyses strong, moderately long. Ostium bursae less sclerotized, shortly funnel-like, wrinkled. Ductus bursae medium long, broadly tubular, membranous with relatively strong scobination and with strong longitudinal wrinkles in medial third. Cervix bursae elliptical, rugulose and finely scobinate, corpus bursae ovoid, weakly membranous, without signa.

Bionomics and distribution: The unique specimen was collected during the day, at a very high elevation in southern Tibet.

Etymology: The specific name refers to the whitish hind wing of the species.

Brachygalea leptographa sp. n.
(Figs 7, 16, 17, 20)

Holotype: female, Turkmenistan, Kara-Kum desert, 200 m, 70 km SW of Repetek, 62°45'E, 38°03'N, 10.V.1991, leg. G. CSORBA, GY. FÁBIÁN, B. HERCZIG, M. HREBLAY & G. RONKAY, deposited in coll. G. RONKAY (Budapest, Hungary). Slide No. 4002 RONKAY.

Paratype: male, S Kazakhstan, Karatau Mts, near Kentau, 600 m, 27.IV.1994, leg. PLIUSHCH, deposited in coll. P. GYULAI (Miskolc, Hungary). Slide No. 5745 RONKAY.

Taxonomic notes: The genitalia in both sexes of all *Brachygalea* species are very similar, the main apomorphic features are the heavily sclerotized, serrate clavus, the long, narrow apical process of the fultura inferior (juxta), the long, sclerotized vinculum, the furcate apical part of the valva (a small, medial lobe may also be present), the long, sclerotized, serrate and dentate bars of the carina of aedeagus and the presence of a large, more or less laminated terminal cornutus of the vesica, the short, sclerotized ostium, rather short, membranous-wrinkled ductus, the large, discoidal, sclerotized cervix and the elongated-elliptical, membranous corpus bursae, bearing two ribbon-like signum-stripes. Some of these features are common synapomophies of the genera *Brachygalea* and *Behounekia* HACKER, 1990 (the serrate, sclerotized clavus, the strong, long vinculum, the serrate carina and the presence of the large terminal cornutus-plate of the vesica), displaying the supposed sister-group relationship of the two genera.

On the basis of the genital features mentioned above, *Lithophasia cyaxares* WILTSHIRE, 1957, should be transferred into the genus *Brachygalea* (comb. n.) (Figs 33–34).

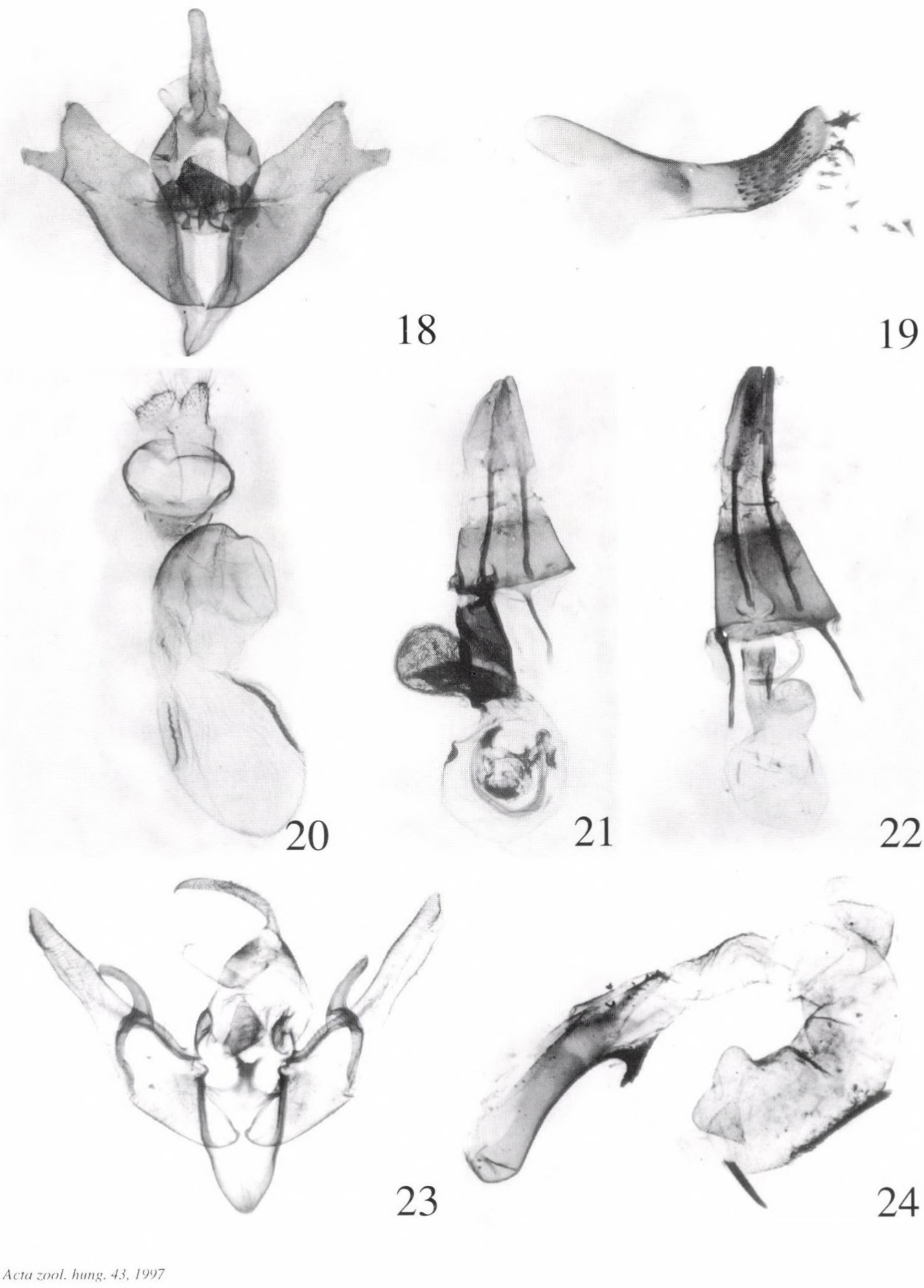
Diagnosis: The five known species of the genus have strongly different external appearance, the type species, *B. albolineata* (BLACHIER, 1905) resembling some *Cucullia ("Pseudocucullia")* species (e.g. *C. capazi* AGENJO, 1952), *B. kalchbergi* STAUDINGER, 1897) being similar to some *Metopoceras* GUENÉE, 1850, and *Recoropha* NYE, 1975, *B.* sp. n. (RONKAY 1997) looking like a large *Calophasia angularis* CHRÉTIEN, 1911, *B. cyaxares* (WILTSHIRE, 1957) being similar to *Lithophasia venosula* STAUDINGER, 1892, while the new species resembles members of the genus *Lophoterges* HAMPSON, 1906.

B. leptographa sp. n. differs from its congeners by its *Lophoterges*-like external appearance and several details of the genitalia. The main specific features of the male genitalia of the new species are the presence of the penicular lobes which are absent in the other four species of the genus, the uncus is significantly longer than those of the allied species, the apex of the valva is shorter, not acute but the outer margin is with an additional, rounded extension, and the apical part of the fultura inferior is short, weak. The female genitalia differ mostly from those of *B. albolineata* and *B. kalchbergi* by its longer, more trapezoidal ostium bursae. The genitalia of the related species are illustrated by VARGA & RONKAY (1991), RONKAY & RONKAY (1995) and RONKAY (1997).

Description: Wingspan 24–27 mm, length of forewing 11.5–13 mm. Head and thorax pale, ochreous slate-grey, collar and tegulae marked with blackish lines, metathoracic tuft large, dark brown-grey; antennae filiform in both sexes. Abdomen slender, paler greyish, dorsal crest well-developed, dark brown. Forewing narrow, elongated, with apex pointed, ground colour pale, shining slate-grey with fine ochreous-brownish shade. Wing pattern fine, streak of submedian fold long, blackish, sharply defined, veins partly covered with darker grey-brown. Ante- and postmedial crosslines strongly sinuous, more or less interrupted, blackish, defined with whitish; medial line absent. Stigmata present, encircled with dark brown and whitish, orbicular and claviform flattened, long, former with darker brownish, latter with whitish centre. Reniform lunulate, narrow, filled with ground colour. Subterminal fine, white, strongly sinuous, defined by blackish brown arrowheads on both sides, tornus with conspicuous, white patch in darker grey-brown field. Terminal line fine, dark brown, cilia as ground colour, finely striolate with whitish and darker brown. Hind wing whitish, veins and broad marginal area suffused with brown; discal spot shadow-like. Terminal line fine, dark brown, cilia whitish with a fine brownish stripe medially. Underside of both wings whitish with fine greyish and darker brown irroration, discal spots present but pale, transverse lines missing.

Male genitalia (Figs 16–17): Uncus long, slender, tegumen high, with elongated, apically rounded, densely setose subapical penicular lobes ("socii"). Fultura inferior deltoidal, apical process short, weakly sclerotized, vinculum long, strong, U-shaped. Valvae symmetrical, elongated apical part slightly dilated, forming more or less quadrate cucullus. Apex finely pointed, outer margin laced, ventral margin terminated in a strong, acute, finely curved process; corona absent. Sacculus long, clavus a long, heavily sclerotized, serrate crest, its inner process large, apically rounded. Harpe reduced to its weak basal plate, pulvillus long, sclerotized, densely setose. Aedeagus cylindrical, arcuate, carina with long, broad, sclerotized ventro-lateral bar, its ventral edge strongly dentate. Vesica broadly tubular, everted forward, then upturned and recurved ventro-laterally. Basal third of vesica with three groups of fine, spiculiform cornuti, medial third with larger field of somewhat longer spinules, terminal third with big, flattened, sclerotized plate ("cornutus") and small, semiglobular diverticulum nearby ductus ejaculatorius. Abdominal coremata completely reduced.

Figs 18–24. 18–19 = *Hypomecia quadrivirgula* (MABILLE), male genitalia; 20 = *Brachygalea leptographa* sp. n., female genitalia, holotype; 21 = *Isochlora grumi* ALPHERAKY, female genitalia; 22 = *I. maxima* STAUDINGER, female genitalia; 23–24 = *Agrochola azerica* sp. n., male genitalia, holotype



Female genitalia (Fig. 20): Ovipositor short, weak, gonapophyses fine, short. Ostium bursae flattened, trapezoidal, granulosely sclerotized on both surfaces. Ductus bursae short, flattened, membranous with fine wrinkles. Cervix bursae huge, discoidal, apical part smoothly sclerotized, corpus bursae elliptical, with two long, inequal signum-stripes. Sternite VIII with two, more or less quadrangular, granulosely sclerotized plates.

Bionomics and distribution: The new species was found in desert habitats, in late spring; both specimens were collected by light.

Etymology: The specific name reflects to the fine dark grey-brown and white forewing markings.

Agrochola (Alpichola) azerica sp. n.
(Figs 5, 6, 23, 24)

Holotype: Male, Azerbaijan, Talysh Mts, Massallynski distr., Ysti-su, 27.10.1988, leg. KAZARIAN, deposited in coll. P. GYULAI (Miskolc).

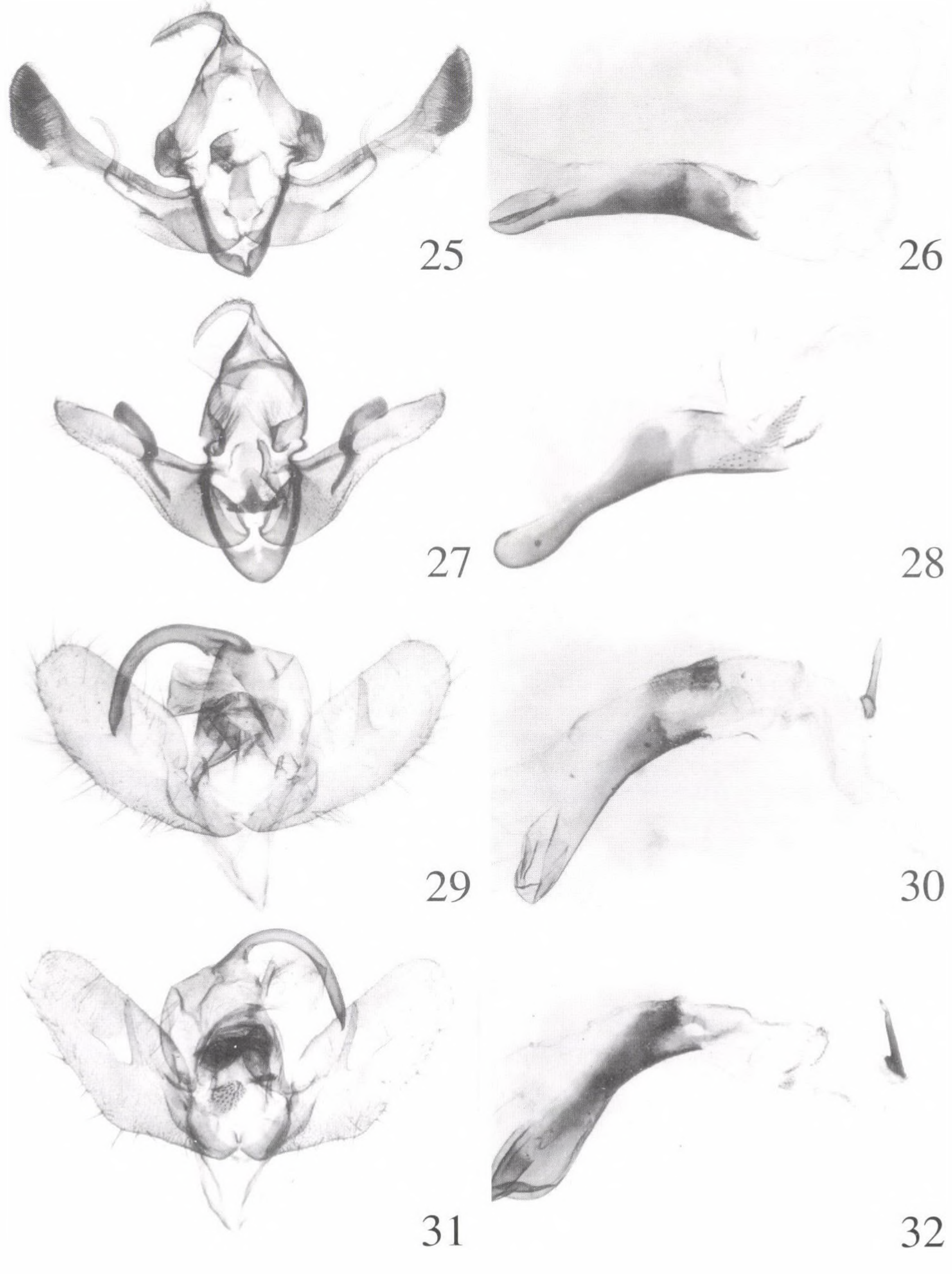
Paratypes: 2 males, with same data as holotype, deposited in coll. G. RONKAY (Budapest) and A. V. NEKRASOV (Moscow). Slide Nos 703 GYULAI, 4896 NEKRASOV.

Diagnosis: The new species belongs to the subgenus *Alpichola* RONKAY, 1984, its closest relative is *A. egorovi* (BANG-HAAS, 1934). It externally resembles the yellowish species occurring in Asia Minor and the Caucasus region, *A. egorovi*, *A. janhillmanni* HACKER & MOBERG, 1989 and *A. lactiflora* (DRAUDT, 1934), differing from them by its dark orange-yellowish ground colour with rather strong orange-brownish irroration in the medial field and the interrupted, diffuse, dark brown-grey but not whitish-ochreous crosslines. The male genitalia differ from those of *A. egorovi* by the less distinct apical processus of the fultura inferior, the longer, narrower, less dentate dorsal plate of the carina, the presence of a rugulose-cristate, sclerotized field of the basal tube of the vesica, the equally long spinules of the terminal cornuti field and the larger quadrangular terminal diverticulum.

The male genitalia of the species of the subgenus *Alpichola* are illustrated by VARGA & RONKAY (1991).

Description: Wingspan 26–28.5 mm, length of forewing 13–14.5 mm. Palpi short, antenna of male finely dentate. Head and thorax dull yellowish, collar and edges of tegulae somewhat darker, antenna of male finely pectinate; abdomen more ochreous. Forewing rather high triangular with apex pointed, outer margin finely concave below apex. Ground colour orange-yellowish, irrorated with orange-brownish in medial field and at termen. Wing pattern diffuse, ante- and postmedial crosslines double, more or less interrupted, sinuous, dark brown-grey, filled with ground colour, median fascia variably strong, diffuse, brownish. Orbicular stigma rather indistinct, incompletely encircled by brown, marked with some dark spots; claviform small, rounded, dark brown dot. Reniform well-discernible, encircled with darker brown-grey and filled partly with greyish. Subterminal and terminal lines represented by rows of brownish spots, cilia orange-yellowish. Hind wing pale ochreous, inner area suffused variably strongly with greyish brown, discal spot and transverse line present but pale, shadow-like. Terminal line interrupted, brown, cilia pale ochreous.

Figs 25–32. Male genitalia. 25–26 = *Pseudohadena (s. l.) nobilis* sp. n., holotype; 27–28 = *Pulcheria catomelas* ALPHERAKY; 29–30 = *Euchalcia aureolineata* sp. n., paratype; 31–32 = *E. emichi* ROGENHOFER et MANN



Underside of wings whitish-yellow, scarcely irrorate with brown. Discal spots, trace of orbicular and transverse line of forewing well-discernible.

Male genitalia (Figs 23, 24): Uncus medium-long, slender, apically hooked, tegumen rather low, weak, penicular lobes small, rounded, densely hairy. Fultura inferior subdeltoidal, apical processus rather weak, short, lateral arms relatively long, vinculum strong, V-shaped. Valva very long, narrow, apically tapering, apex pointed; cucullus small, triangular, corona very short, weak. Sacculus short, rounded, clavus reduced. Harpe strong, thick, arcuate, pulvillus narrow, densely setose. Aedeagus cylindrical, relatively short, carina with strong, dentate ventral hook, narrow lateral and narrow, serrate dorsal bar continued in broad, wrinkled, granulosely sclerotized lamina of basal tube of vesica. Vesica everted forward and recurved ventrally, basal part narrow, medial and distal parts dilated, finely scobinate, medial part bearing long, tubular diverticulum, terminal part with long spinulose field consisting of short, fine spinules, quadrangular, scobinate diverticulum and medium-long, pointed terminal cornutus.

Bionomics and distribution: The new species was discovered in the south-eastern part of the Caucasus region. The specimens were collected by light, at the end of October.

Etymology: The specific name is derived from the country where the species was found.

Pseudohadena (s. l.) nobilis sp. n.
(Figs 8, 25, 26)

Holotype: Male, China, Xining, Daban Shan, 8.VIII.1996, deposited in coll. P. GYULAI (Miskolc). Slide No. 5824 RONKAY.

Taxonomic notes: The generic complex of the former genus *Pseudohadena* ALPHERAKY, 1889, was split into three distinct genera by RONKAY, VARGA & FÁBIÁN (1995), mentioning that the taxonomic interpretation of the remaining species groups requires further studies on the tribes Apameini and Xylenini. This new species is a representative of one of the species-groups the supraspecific status of which has not yet been clarified. Therefore, it is tentatively placed into *Pseudohadena* (s. l.).

Diagnosis: The new species belongs to the *presbytis–clementissima* species-group, resembling more the latter species by its size and long, narrow forewings. It differs from its relatives by its ochreous ground colour, less sharply defined, paler brownish, not blackish crosslines and outlines of stigmata and the reddish subterminal line. *P. (s. l.) nobilis* also resembles *Pulcheria cinescens* DRAUDT, 1934, but is larger in size, the ground colour is ochreous and the forewing markings are less sharply defined. The wing shape and some features of the forewing pattern are also similar to those of the species of *Nekrasovia* RONKAY & VARGA, 1993, but the antenna of the new species is much more shortly bipectinated and the ground colour is not bluish-grey; the genitalia of the *Pulcheria* ALPHERAKY, 1887, and the *Nekrasovia* species show significant differences compared with those of the members of the *P. presbytis*-group.

The male genitalia of *P.* (s. l.) *nobilis* differ from the allied *P. presbytis* and *P. clementissima* by the smaller aedeagus with very simple, weakly membranous vesica lacking the terminal cornutus and any scobination of the walls and by the narrower, higher fultura inferior. The harpe is finer, the costal extension is shorter than those of *P. clementissima* but stronger, longer than in case of *P. presbytis*. The aedeagus and vesica of the new species also resembles those of *Pulcheria catomelas* ALPHERAKY but the clasping apparatus of the two species are strongly different (see Figs 25–28).

Description: Wingspan 45 mm, length of forewing 21 mm. Head and thorax pale sand-brown mixed with few greyish, palpi and tegulae marked with darker grey. Antenna shortly bipectinate. Abdomen slender, paler ochreous-grey. Forewing long narrow, with apex pointed, outer margin slightly concave below apex. Ground colour shining, pale ochreous-brown, basal area and inner half or marginal field irrorate with darker brownish-grey. Subbasal line sinuous, darker brown, with elongate, plumbeous streak below costa. Antemedial line rather diffuse, double, sinuous, darker brownish filled with ground colour, medial line poorly visible, red-brownish shadow. Postmedial sharply defined, simple, less sinuous, fine dark brown line with lighter outer shadow. Stigmata present, orbicular and reniform flattened, narrow, encircled with darker brown and ochreous, marked with plumbeous grey spots and patches inside; claviform elongated, darker brown with lighter centre. Subterminal rather broad, sinuous, reddish-brown, defined by paler ochreous outer shadow. Terminal line fine, sharply defined, blackish, cilia ochreous-brown with creamy whitish basal line. Hindwing shining whitish-ochreous, irrorated with brownish, veins covered with dark brown, inner half of marginal area with stronger brown suffusion. Discal spot absent, transverse line diffuse but visible, terminal line fine, dark brown, cilia ochreous. Underside of wings shining ochreous, inner area of forewing suffused with dark grey. Discal spot of forewing whitish, transverse line diffuse but visible on both wings.

Male genitalia (Figs 25, 26): Uncus short but strong, slender, apically hooked, tegumen wide, moderately high, penicular lobes broad. Fultura inferior narrow, sclerotized, subdeltoidal with rather wide apical part, vinculum short, strong, V-shaped. Valva long, narrow, apical part slightly dilated, cucullus broadly triangular, densely setose, apex finely pointed, corona long, fine. Sacculus short, clavus less developed, rounded, setose lobe. Harpe long, fine, arcuate, costal extension strong, relatively short, wedge-shaped. Aedeagus small, tubular, arcuate, ventral part of carina sclerotized. Vesica weakly membranous, everted forward and upturned dorsally, basal half broad, spacious, ventral part covered with minute hair-like spiculi, distal half tapering, more or less tubular. Abdominal coremata well-developed.

Bionomics and distribution: The unique specimen of the new species originates from the mountain steppes of the Daban Shan, eastern border of the Kuku-Noor area.

Etymology: nobilis = noble.

Euchalcia aureolineata sp. n.
(Figs 9, 10, 29, 30)

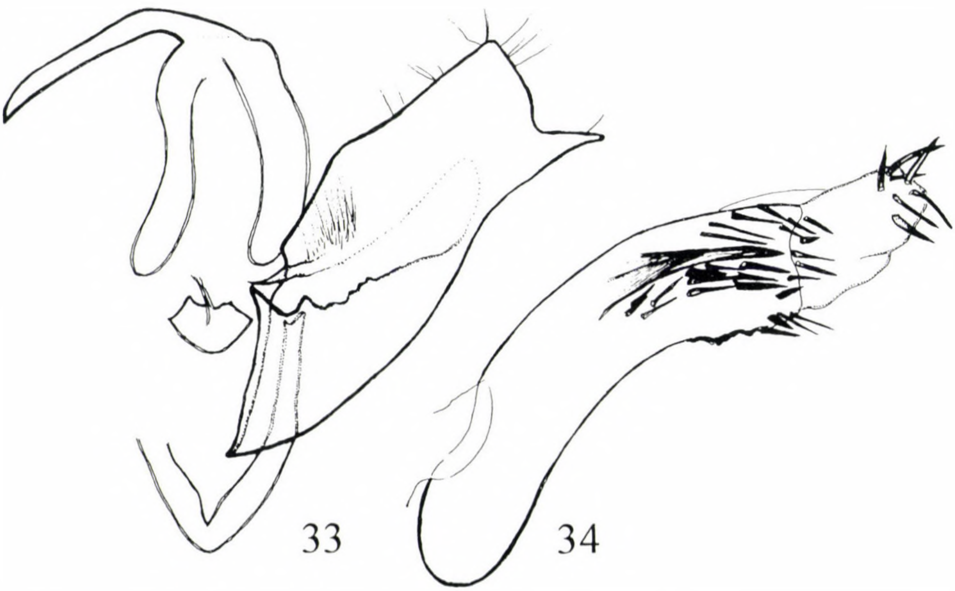
Holotype: Male, Syria, Ma'lúlá, 33°53'N, 36°38'E, 17.V.1995, leg. P. ROHLENA, deposited in coll. P. GYULAI (Miskolc).

Paratype: Male, with same data, coll. G. RONKAY (Budapest). Slide No. 5744 RONKAY.

Diagnosis: The new species externally resembles *E. maria* (STAUDINGER, 1891), *E. kautti* HACKER et RONKAY, 1993, and *E. emichi* (ROGENHOFER et MANN, 1873), but differs from its relatives by its golden brilliance, fine olive-greenish suffusion and more diffuse, golden-ochreous – not whitish – crosslines. The crosslines of *E. aureolineata* are less oblique, the postmedial is less straight than those of *E. kautti* and *E. maria*; the hindwing of the new species is more unicolorous, and essentially darker than in the case of *E. maria* and *E. emichi*.

The male genitalia of the new species is most similar to those of *E. emichi* (Figs 31, 32) but the valva is shorter but broader, more rounded, its ventral margin is arcuate, not angled at end of sacculus, the harpe is shorter, thicker, situated more distally, the apical process of the fultura inferior is stronger, narrower, more process-like, the vesica is shorter but broader, the diverticulum bearing the cornutus is more expressed.

Description: Wingspan 25.5–27 mm, length of forewing 12–13 mm. Head and thorax brown, irrorated with ochreous hairs with white tips, base of collar pale yellowish, metathoracic tuft large. Abdomen ochreous, dorsal tuft of 2nd segment large, dark brown. Forewing short, high triangular with apex acute, outer margin evenly arcuate. Ground colour dark ochreous brown with olive-greenish suffusion and golden brilliance, medial and marginal fields scarcely irrorate with silvery white and golden scales. Basal area narrow, golden-ochreous, ante- and postmedial lines more or less straight, double, rather diffuse, golden-ochreous, marked with some brownish. Orbicular, reniform and subcellular stigmata present, finely encircled with silvery white and filled with dark reddish brown, darkest parts of the wing. Orbicular small, rounded, reniform elliptical, constricted



33 34

Figs 33–34. Male genitalia of *Brachygalea cyaxares* (WILTSHIRE), holotype

at middle, subcellular more or less rounded, larger than orbicular. Subterminal line obsolescent, silvery whitish, terminal line very fine, hardly visible, dark red-brown. Cilia pale brown with somewhat ochreous outer half and darker medial line. Hind wing nearly unicolorous, dark fuscous, marginal area slightly darker; cilia brown with fine, pale yellow basal line. Underside of wings greyish brown, weakly irrorate with ochreous, hind wing somewhat lighter.

Male genitalia (Figs 29, 30): Uncus strong, rather slender, curved, apex finely hooked. Tegumen low, narrow, fultura inferior rounded deltoidal plate with long, narrow apical process; vinculum short, V-shaped. Valva relatively short, broad, ventral margin arcuate, apex rounded. Sacculus very short, clavus long, digitiform, apically setose. Harpe situated medially, rather thick, straight, cuneate. Aedeagus shortly cylindrical, arcuate, carina with two relatively weak lateral bars. Vesica tubular, everted forward, slightly turned ventrally. Basal half broader, finely scobinate, medial part with narrow cross-ring consisting of stronger scobination and tiny spiculi, distal half tapering, armed with long, strong, nail-shaped cornutus on small diverticulum.

Bionomics and distribution: The new species inhabits desert-like rocky places, it is known from SW Syria, in the vicinity of Dimashq.

Etymology: The specific name refers to the pale golden crosslines of the species.

* * *

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NEW TAXA OF THE GENERA AUCHMIS HÜBNER, [1821] AND NEKRASOVIA RONKAY ET VARGA, 1993 (LEPIDOPTERA, NOCTUIDAE)

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Descriptions of *Auchmis martini* sp. n. (China), *A. detersa margarita* ssp. n. (Turkmenistan), *A. mongolica expallescens* ssp. n. (China), *A. curva zolitudia* ssp. n. (Russia, Altai), *A. peterseni nekrasovi* ssp. n. (Azerbaijan) and *Nekrasovia sinica* sp. n. (China) are given. With 25 figures.

Key words: Noctuidae, new species and subspecies, *Auchmis*, *Nekrasovia*

INTRODUCTION

Our knowledge of the taxonomy and biogeography of the genus *Auchmis* HÜBNER, [1821] and the related *Nekrasovia* RONKAY et VARGA, 1993 has increased considerably during the last ten years. One of the main reasons of this noteworthy development is the re-examination of the ancient materials of some "well-known" species, including their type series, revealing the fact that these series are often mixed, consisting of more than one, sometimes not very closely allied species (e.g. of *A. detersina* (STAUDINGER, 1896) and *A. incognita* RONKAY et VARGA, 1990). On the other hand, these studies have led to the separation at the generic level of *Nekrasovia* species group, considered as *Auchmis* by BOURSIN (1960), and the description of the second species of the group. Another reason is that the intensification of the collectings in some, formerly less explored area, especially in Central Asia and the Himalayan–Tibetan region, has resulted in important, large, new material of *Auchmis* species, containing several formerly unknown taxa (PLANTE 1986, HACKER & WEIGERT 1990, RONKAY & VARGA 1990, 1993, VARGA & RONKAY 1991, HREBLAY & RONKAY 1997). The synopsis of the genus was first published by HACKER & WEIGERT (1990), subsequently by RONKAY & VARGA (1993).

The present paper contains the new discoveries from the last five years, with some comments on their bionomics and zoogeography.

The holotypes, deposited in the collections of G. RONKAY and Z. VARGA, are available for study through the Hungarian Natural History Museum, Budapest.

Auchmis martini sp. n.
(Figs 1, 13, 14)

Holotype: Male, "Chine. nord A. David.", "Ex Oberthür Coll. Brit. Mus. 1927–3", "1954/765" (slide No. of TAMS), "Noctuidae Brit. Mus. slide No. 11899 ♂" (blue label). Deposited in The Natural History Museum, London (BMNH).

Diagnosis: The new species is very similar to the less marked, pale specimens of *Auchmis detersa* (ESPER, [1787], but the streak of submedian fold (basal dash) is somewhat longer, with its brownish underline running to subterminal line and the hindwing is darker, more brownish with less darkened veins. *A. martini* also resembles *A. detersina* and *A. incognita*, but these two species have significantly sharper forewing markings, especially the reniform stigma is more sharply defined. The male genitalia of *A. martini* are unique within the genus by their bifid ampulla and, in addition, the harpe is much shorter than those of *A. detersa, A. incognita, A. composita* PLANTE, 1986 and *A. imbi* RONKAY et VARGA, 1993 and the armature of the vesica is also clearly different from the related taxa by its huge basal cornutus and dentate, bar-like distal cornuti.

Description: Wingspan 48 mm, length of forewing 23 mm. Head, collar and tegulae pale ashy grey, mixed with brownish, frons, collar, edges of tegulae and thoracic tufts marked with dark brown, medial part of thorax also dark brownish. Antennae of male ciliate. Forewing long, narrow, with apex pointed, outer margin finely crenulate. Ground colour pale ash-grey, irrorated strongly with brown, outer part of marginal area entirely brownish. Wing pattern rather indistinct, ante- and postmedial lines pale, shadow-like, double, sinuous. Streak of submedian fold (basal dash) very long, black, marked with brownish below, this brownish line very long, running through median area, almost fused with subterminal line; streak of inner margin short, blackish. Orbicular and reniform stigmata partly fused, encircled finely with dark brown, their centres somewhat darker than ground colour, claviform flattened, marked with an incomplete black outline. Subterminal line strongly sinuous, whitish grey, marked with fine black lines between veins and dark outer part of marginal area. Terminal line row of fine blackish arches, cilia light grey, spotted with whitish and darker brown. Hindwing shining ochreous white, suffused with brownish. Veins, small discal spot and broad marginal area darker brown, terminal line dark brown, cilia whitish. Underside of wings ochreous-whitish, forewing strongly suffused, hind wing irrorated with brown; transverse lines and discal spot of forewing shadow-like, discal spot of hind wing much stronger, dark brown.

Male genitalia (Figs 13, 14): Uncus long, slender, curved, tegumen narrow, moderately high, penicular lobes very small. Fultura inferior large, high, calyculate with deep apical incision and fine, long basal bar connected with main plate by membranes; vinculum very short, strong, U-shaped. Valva large, elongated, costal margin arcuate, ventral margin with large, finely quadrangular subapical lobe. Cucullus broad, triangular with apex acute, corona long. Sacculus short, rounded, clavus reduced, harpe broad-based, sclerotized, short, medially curved, apically slightly dilated and rounded. Ampulla also wide-based, bifid with long, falcate, acute upper (dorsal) and much shorter, cuneate lower (ventral) process. Aedeagus long, cylindrical, finely arcuate, carina

with large, finely scobinate dorso-lateral plate. Vesica broadly tubular, upturned, distally tapering, with two subbasal diverticula, one of them bearing huge, claw-like cornutus, distal part with large, conical diverticulum, armed with dentate, narrow, bar-like cornutus.

Bionomics and distribution: Almost unknown, the unique specimen was collected in north China, more detailed data of the locality and date of the collecting are not given.

Etymology: The new species is dedicated to Mr MARTIN R. HONEY, Curator of the nocturnal Macrolepidoptera collection of The Natural History Museum, London.

Auchmis detersa margarita ssp. n.
(Figs 2–4, 15, 16)

Holotype: Male, "Turkmenistan, Kopet-Dagh Mts, 6 km S of Ipay-Kala, 1600 m, 57°07'E, 38°17'N, 16–23.VIII.1992, leg. M. Hreblay, Gy. M. László & G. Ronkay" (deposited in coll. G. RONKAY).

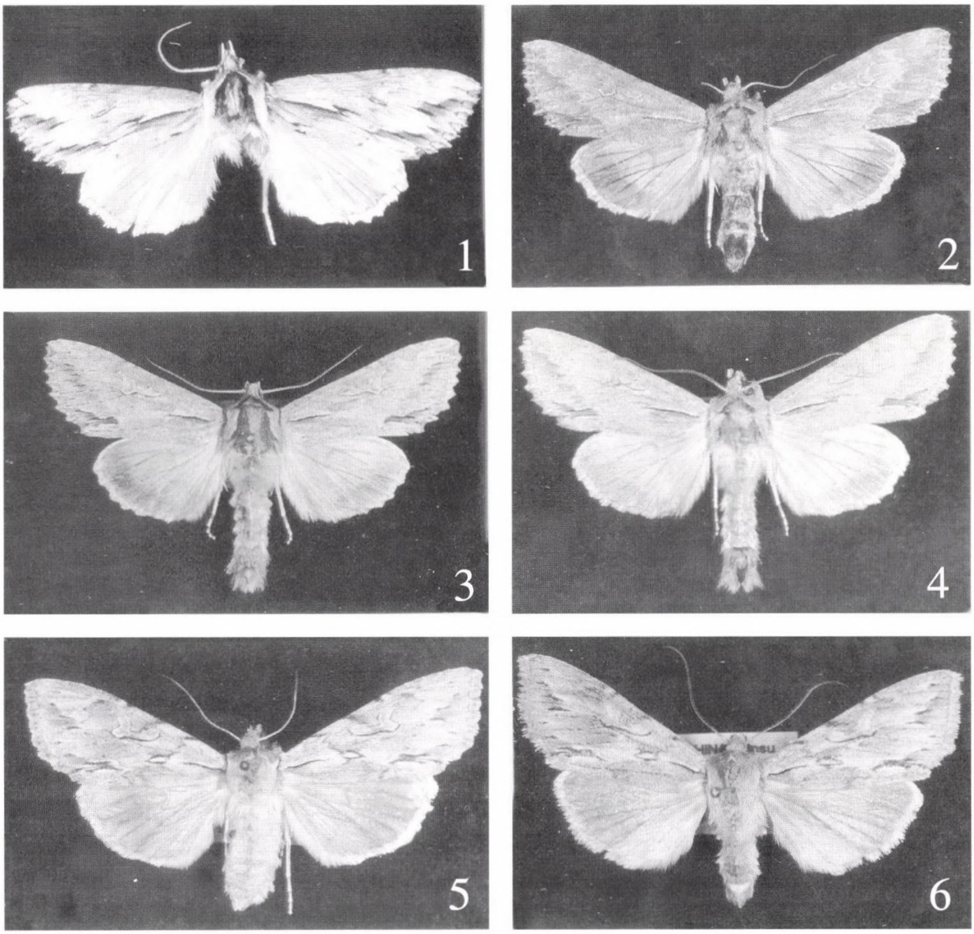
Paratypes: A large series of both sexes with the same data as the holotype; Kopet-Dagh Mts, Dushak Mt., 57°56'E, 37°54'N, 1500 m, 7–8.VIII.1992; Dushak Mt., 57°54'E, 37°57'N, 2400 m, 9–10.VIII.1992, leg. M. HREBLAY, GY. M. LÁSZLÓ & G. RONKAY; Mt. Dushak, 15 km W Firyuza, 29.VIII.1988, leg. V. V. DUBATOLOV. The specimens are preserved in the collections of the HNHM (Budapest), and of the collectors, GY. FÁBIÁN (Budapest), P. GYULAI (Miskolc), B. HERCZIG (Tata) and Z. VARGA (Debrecen).

Slide Nos RL5900 (male), RL5909 (female).

Diagnosis: The easternmost subspecies of *A. detersa* (ESPER, [1791]), mostly resembles the Cretan ssp. *minoica* REISSER, 1958 by its very pale forewing coloration with fine shining and reduced dark markings, differing strongly from the populations occurring in Eastern Turkey, the Caucasus region and the Elburs Mts (ssp. *demavendi* SCHAWERDA, 1955), having much darker greyish forewings with sharply defined dark markings. The forewings of *A. detersa margarita* are pale, bluish ashy grey with very few brownish scales, the scaling is finely reticulate. The crosslines are more obsolescent than in other races of the species, even the subterminal is often shadow-like, its wedge-shaped marks are small, often diffuse. The hindwing coloration differs from that of the other East European–West Asian populations, the male has paler brownish marginal area but with fine brownish suffusion on the inner part of the wing, therefore the whole wing is less whitish, the discal spot is present, regularly well-discernible; the female has stronger brownish suffusion in the inner area but the colour of the marginal area is less intense brown.

The male genitalia of *A. detersa margarita* (Figs 15, 16) differ from those of the eastern European, Turkish and Caucasian populations (Figs 17, 18) by its shorter but broader, apically more curved valvae with smaller, significantly narrower, more acute cucullus, and the harpe is shorter, less curved.

Description: Wingspan 41–46 mm, length of forewing 18–21 mm. Head, collar and tegulae pale ashy grey, mixed with brownish, frons, collar, edges of tegulae and thoracic tufts marked with blackish. Forewing long, narrow, with apex pointed, outer margin finely crenulate. Ground colour pale, shining ash-grey, irrorated with some brown and whitish, scaling finely reticulate. Wing pattern obsolescent, traces of ante- and postmedial lines diffuse, often hardly recognizable. Streak of submedian fold (basal dash) long, blackish-brown. Orbicular and reniform stigmata rather indistinct, often partly fused, encircled partly with fine blackish and whitish-grey lines, their filling slightly paler than ground colour. Claviform absent or reduced to its incomplete black outline. Subterminal line strongly sinuous, whitish grey, rather indistinct, marked with fine blackish streaks. Hind wing shining whitish, with fine brownish suffusion. Veins, small discal spot and marginal area darker brown, terminal line dark brown, cilia whitish. Underside of wings creamy whitish,



Figs 1–6. 1 = *Auchmis martini* sp. n., holotype male; 2 = *A. detersa margarita* ssp. n., paratype female; 3 = *A. detersa margarita* ssp. n., holotype male; 4 = *A. detersa margarita* ssp. n., paratype male; 5 = *A. mongolica expallescens* ssp. n., paratype female; 6 = *A. mongolica expallescens* ssp. n., holotype male

forewing with stronger, hindwing with scarce brownish irroration; transverse lines and discal spots present, often diffuse, shadow-like.

Male genitalia (Figs 15, 16): Uncus long, slender, evenly curved, tegumen narrow, high, penicular lobes very small. Fultura inferior small, quadrangular with finely rounded apical part; vinculum very short, strong, U-shaped. Valva large, elongated, distally broadened, costal margin arcuate, ventral margin with large, rounded subapical lobe. Cucullus small, narrow, high triangular with apex pointed, corona long. Sacculus short, rounded, clavus reduced, harpe thick, strong, curved, dorsal margin serrate, with apex acute. Ampulla long, slender, arcuate, its tip pointed. Aedeagus long, cylindrical, finely arcuate, carina with large, finely scobinate dorsal and much stronger, dentate ventral plate. Vesica broadly tubular, upturned, recurved ventrally, basal part with large, sclerotized, partly cristate and wrinkled lamina, distal part with large, rounded terminal cornuti field consisting of long, fine spinules.

Bionomics and distribution: The Turkmenian populations of *A. detersa* inhabit xerothermic steppes and shrubby biotopes at medium-high to high elevations of the Kopet-Dagh Mts, appearing as a frequent but not common species. The specimens are strongly attracted to artificial light.

Etymology: the name refers to the fine shining of the forewings.

Auchmis mongolica expallescens ssp. n.
(Figs 5, 6, 19, 20)

Holotype: Male, "China, Gansu, Xiahe, 3000 m, 26.VII.1994, leg. Westphal" (coll. THÖNY, deposited in HNHM, Budapest).

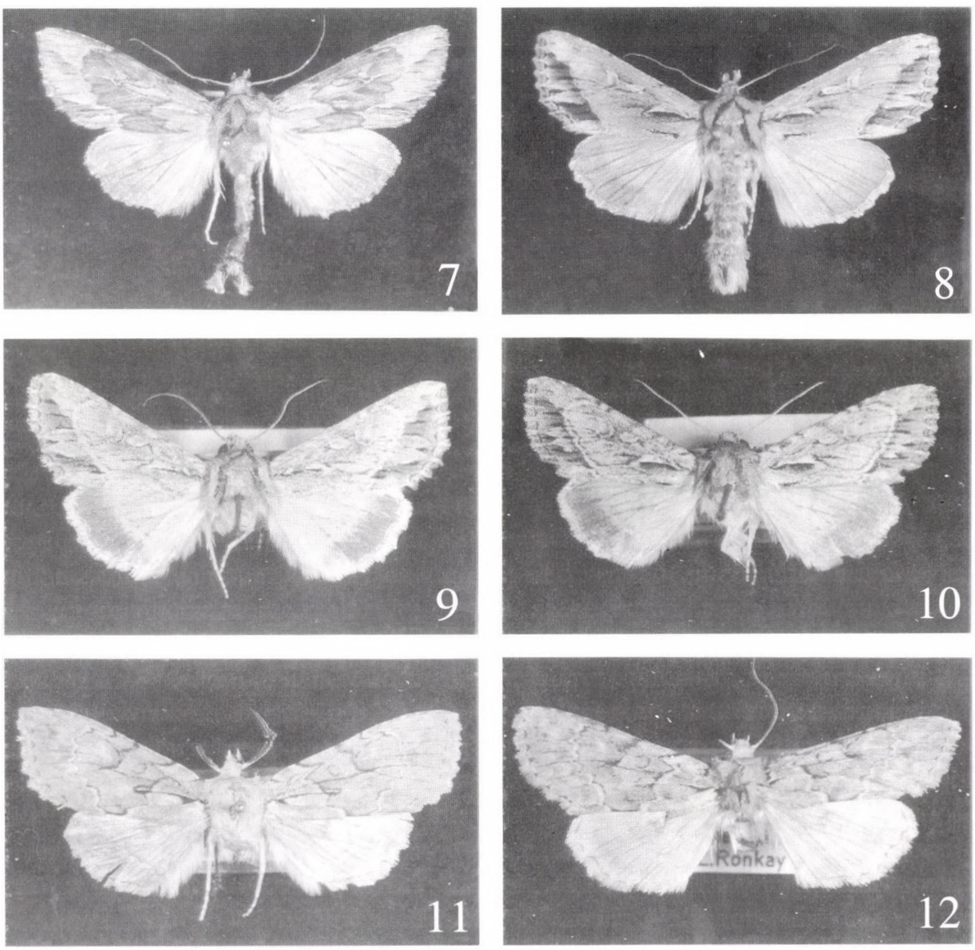
Paratypes: A series of both sexes, with the same data as holotype and from Gansu, Xiahe, Labrang, 2900 m, 14–24.VII.1991, leg. P. SALK; Gansu, Xiahe, Labrang, 3000–3400 m, 14–24. VII.1991, leg. WESTPHAL (deposited in coll. HNHM, Budapest).

Slide Nos RL5506, RL5511 (males).

Diagnosis: The southernmost subspecies of *A. mongolica* (STAUDINGER, 1896) is more or less equal in size to the nominate subspecies and larger than the southern Mongolian *A. m. pergrata* RONKAY et VARGA, 1990 (*mongolica pergrata*: wingspan 38–40 mm, length of forewing 18–19 mm; *mongolica expallescens*: wingspan 40–45 mm, length of forewing 19–21 mm). *A. m. expallescens* differs from *A. m. mongolica* by its significantly paler greyish ground colour with fine ochreous-bronze shining and fine brownish irroration, the dark forewing pattern is less sharply defined, the blackish streaks and the dark suffusion of the marginal area are conspicuously paler, the hindwing coloration is lighter, less uniformly brown. The new subspecies is larger than *A. m. pergrata*, the forewings are broader with more ochreous-greyish ground colour, more variegated, stronger forewing pattern, the hindwings are less unicolorous, the inner area is more whitish-ochreous. The male genitalia of the three subspecies of *A. mongolica* show no significant differences, those of *A. m. expallescens* are illustrated in Figs 19, 20.

Description: Wingspan 40–45 mm, length of forewing 19–21 mm. Head, collar and tegulae pale ash-grey, mixed with some brownish and white, antennae of male ciliate. Forewing long, nar-

row, with apex pointed, outer margin finely crenulate. Ground colour pale ash-grey, with fine ochreous-bronze shining, slightly variegated with whitish-grey and ochreous brown, outer part of marginal area suffused with grey-brownish. Wing pattern fine, crosslines rather indistinct, shadow-like, double, sinuous. Streak of submedian fold (basal dash) short, fine, orbicular and reniform stigmata partly fused, encircled partly with blackish, their filling paler than ground colour, reniform also marked with whitish grey. Claviform short, flattened, encircled with blackish, filled with whitish, medial field with ochreous-whitish patch below cell at tip of claviform. Subterminal line strongly sinuous, interrupted, whitish grey, marked with fine black lines between veins and dark outer part of marginal area. Hindwing shining whitish-ochreous, suffused with brownish, veins, small discal spot and broad marginal area darker brown, terminal line dark brown, cilia whitish. Underside of wings ochreous-whitish, forewing strongly suffused, hindwing scarcely irrorated with brownish grey; transverse lines and discal spots shadow-like, diffuse.



Figs 7–12. 7 = *Auchmis curva zolitudia* ssp. n., paratype, male; 8 = *A. peterseni peterseni* CHRISTOPH, male, Turkmenistan; 9 = *A. peterseni nekrasovi* ssp. n., paratype, male; 10 = *A. peterseni nekrasovi* ssp. n., holotype, male; 11 = *Nekrasovia sinica* sp. n., paratype, male; 12 = *N. sinica* sp. n., holotype, female

Male genitalia (Figs 19, 20): Uncus short, curved, dilated at middle, tegumen broad, moderately high, penicular lobes small. Fultura inferior small, quadrangular with slight apical incision; vinculum short, strong, U-shaped. Valva elongate, medially dilated, costal margin arcuate. Cucullus small, narrow, high, with apex pointed, corona long. Sacculus short, rounded, clavus reduced, harpe long, flattened, sclerotized, apex obtuse with fine tip. Ampulla long, distal third dilated, strongly angled to ventral margin, with apex pointed. Aedeagus medium-long, thick, dorsal plate of carina broad, granulose, ventral bar strong, narrow, terminated in large, dentate cornutus. Vesica broadly tubular, upturned, recurved dorsally, armed with a strong, bulbed, acute subbasal cornutus and a small rounded terminal cornuti field consisting of short spiculi.

Bionomics and distribution: The new subspecies represents the southernmost known population of *A. mongolica*, occurring sympatrically with *A. subdetersa* (STAUDINGER, 1895). The nominotypical *A. m. mongolica* is rather widespread in the edges of the mountain taiga zone in the Russian and the Mongolian Altay, being more or less homogeneous in their area while the populations occurring in the south-eastern part of the range of the species represent two distinct geographic races: *A. m. pergrata* lives in the easternmost part of the Govi Altay (Gurvay Sayhan Mts), *A. m. expallescens* at the eastern border of the Kuku-Noor region in China. The imagines are on the wing in the midsummer period, early stages are unknown.

Etymology: the specific name refers to the pale bluish grey coloration of the forewing.

Auchmis curva zolitudia ssp. n.
(Fig. 7)

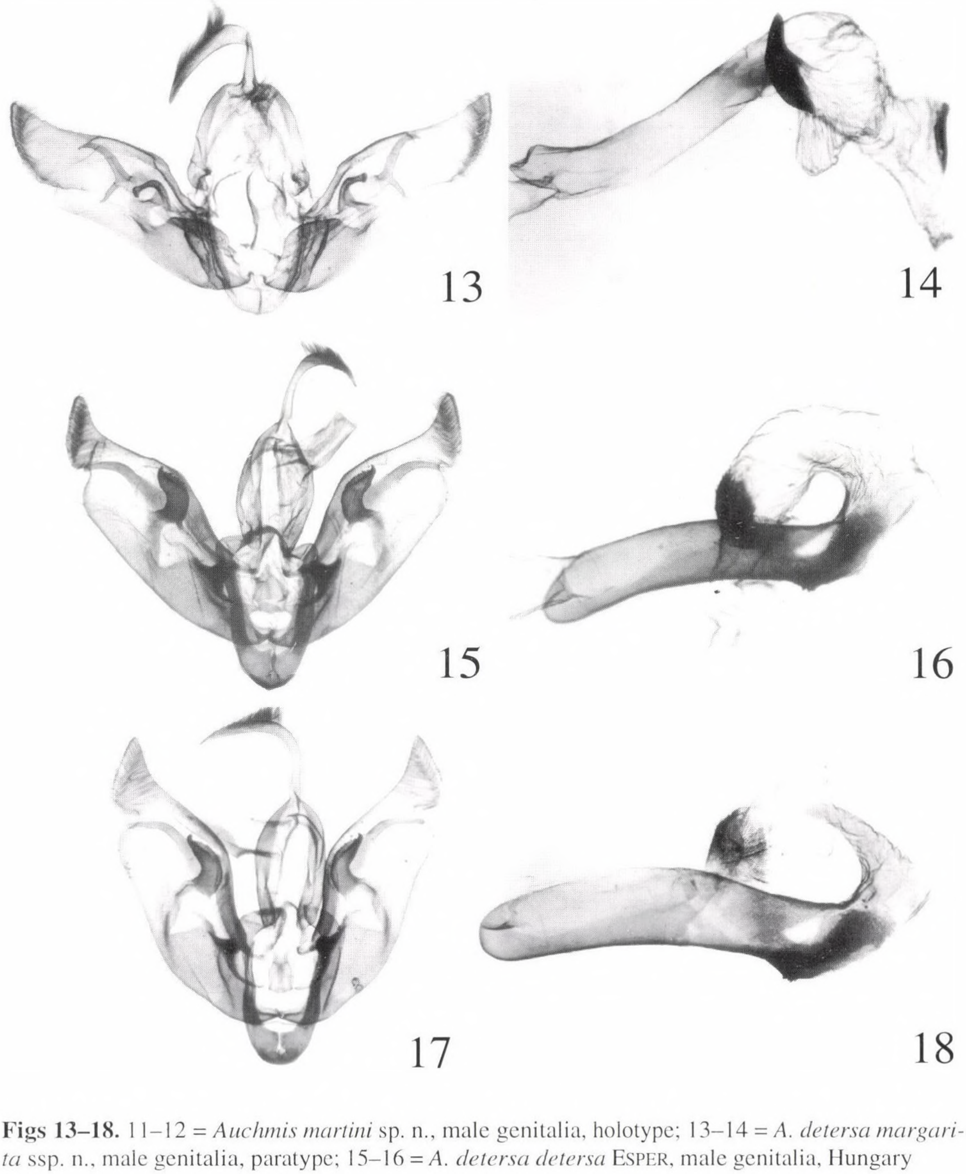
Holotype: Male, "Russia, W Altai Mts, Ongudai, 35 km SE of Ongudai, 1.VIII.1993, leg. Z. Varga & A. Orosz", slide No. 6649 VARGA (deposited in coll. Z. VARGA, Debrecen).

Paratypes: 3 males, 1 female, from the same locality and data, deposited in colls HNHM, G. RONKAY (Budapest), P. GYULAI (Miskolc) and Z. VARGA (Debrecen).

Diagnosis: *A. curva* (STAUDINGER, 1889), a species typical of the Tien Shan massif, is represented by two, externally strongly different geographic races. The new subspecies has the external appearance rather distinct from that of the nominotypical *A. c. curva*, showing closer affinities with *A. c. inquieta* (PÜNGELER, 1914). *A. c. zolitudia* is somewhat larger in size than *A. c. inquieta* (*zolitudia*: wingspan 41 mm, length of forewing 19 mm; *inquieta*: wingspan 39 mm, length of forewing 18 mm), with generally darker coloration: the forewing ground colour is dark brownish grey with stronger brownish suffusion in medial area, the crosslines are more diffuse, the orbicular and reniform stigmata are less sharply defined, the darker suffusion of the hind wing is more expressed, the dark spots of the transverse line are usually missing. The male genitalia of the new subspecies show a series of small differences compared to those of *A. c. curva* and *A. c. inquieta*: the uncus is somewhat longer, stronger, the fultura inferior is broader, almost quadratic, the valva is broader, especially at its medial part, the cucullus is larger, broader, its apex more acute, the ventral plate of the carina and the sclerotized dorsal stripe are stronger, larger. These differences in the male genitalia of the two races of *A. curva* are relatively large, according to the similar

scale of the differences between the two closely related species, *A. curva* and *A. detersina*.

Description: Wingspan 40–41 mm, length of forewing 18–19 mm. Head, collar and tegulae pale brownish grey, mixed with whitish and dark brown, frons, collar, edges of tegulae and thoracic tufts marked with dark brown; antenna of male finely ciliate. Forewing long, narrow, with apex pointed, outer margin finely crenulate. Ground colour pale brownish grey, irrorated with darker grey, medial area suffused with darker brown, veins dark brownish. Wing pattern relatively strong,



Figs 13–18. 11–12 = *Auchmis martini* sp. n., male genitalia, holotype; 13–14 = *A. detersa margarita* ssp. n., male genitalia, paratype; 15–16 = *A. detersa detersa* ESPER, male genitalia, Hungary

ante- and postmedial lines strongly sinuous, blackish brown, defined with paler grey, fused below claviform. Streak of submedian fold (basal dash) long, fine, marked with whitish stripe above it. Orbicular and reniform stigmata small, flattened, partly fused, marked with blackish and whitish lines, their centres somewhat paler than ground colour, reniform with a blackish spot at lower third. Claviform obsolescent, represented by a dark shadow. Subterminal line indistinct, strongly sinuous, whitish grey, marked with fine black lines between veins and dark outer part of marginal area. Hind wing whitish, irrorated with brown, veins and marginal area darker brown, discal spot poorly visible. Underside of wings whitish, forewing strongly suffused, hindwing irrorated with brown; transverse lines and discal spots wide, diffuse.

Male genitalia: Uncus strong, relatively short, curved, tegumen narrow, rather high, penicular lobes small. Fultura inferior quadratic, with fine lateral extensions apically; vinculum short, strong. Valva large, medium-long, distally dilated, ventral margin with fine, rounded subapical lobe. Cucullus broad, triangular with apex pointed, corona long. Sacculus short, clavus narrow, long, setose field, harpe thick, flattened, slightly curved, apex finely rounded. Ampulla relatively short, strong, apically tapering and curved, apex pointed. Aedeagus short, thick, carina with two strong dorso-lateral bars, one of them terminated in a small but strong, pointed plate ("cornutus"), ventral plate large, scaphoidal, heavily sclerotized, dentate. Vesica tubular with broader basal third forming a more or less conical frontal diverticulum, distal part upturned, scobinate.

Female genitalia: Ovipositor relatively short, gonapophyses long, slender. Ostium bursae more or less trapezoidal, wide and short, granulosely sclerotized. Ductus bursae short, proximally tapering, distal part with stronger scobination and wrinkles, proximal part membranous. Cervix bursae very small, rounded, corpus bursae sacculiform, with four long signum-stripes.

Bionomics and distribution: *A. c. zolitudia* is the northernmost known population of the species, inhabiting dry, rocky scrub-steppe habitats in an arid central part of the Russian Altai. The specimens were collected in the midsummer period.

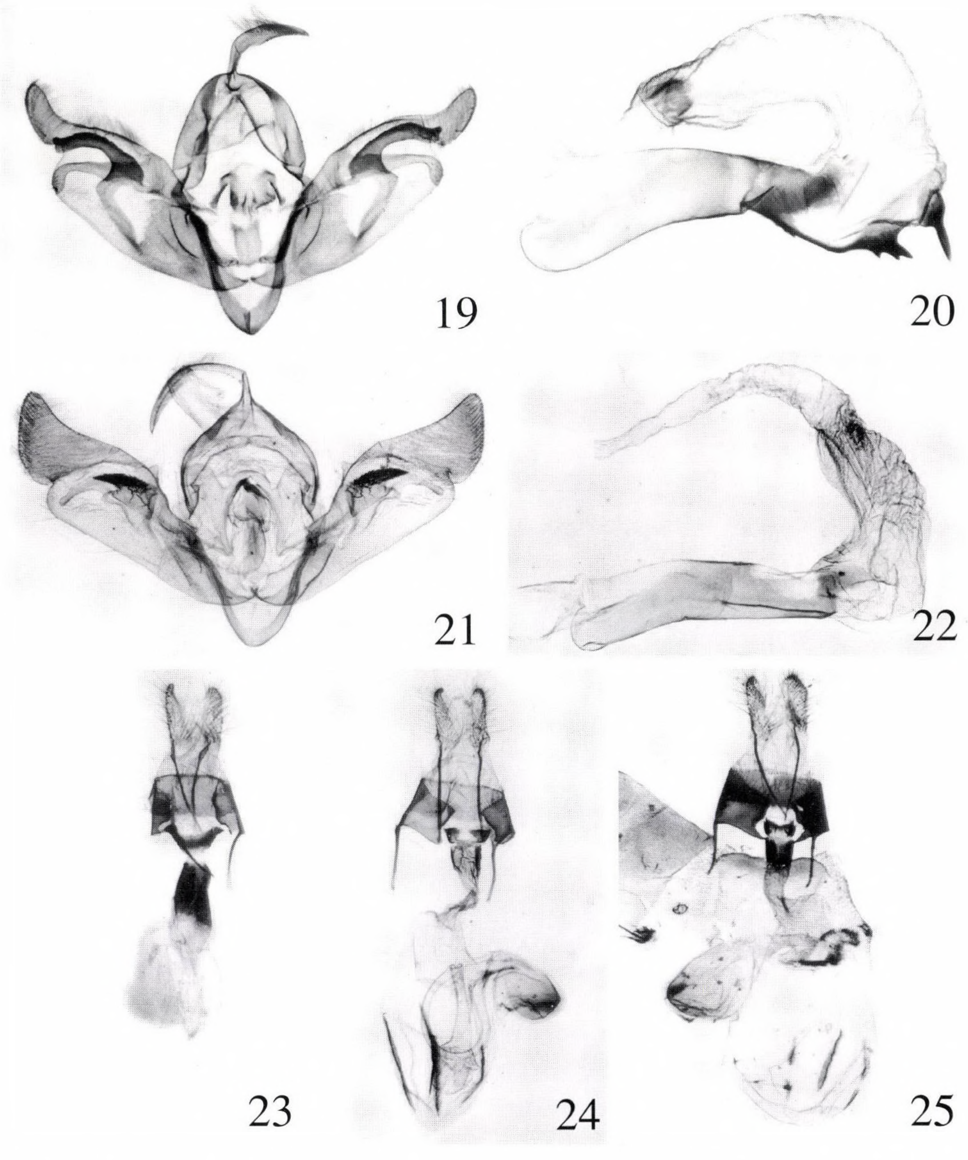
Auchmis peterseni nekrasovi ssp. n.
(Figs 9, 10, 21, 22)

Holotype: Male, Azerbaijan, Nakhichevan, Buzgov, 21.VIII.1985, leg. O. GORBUNOV (deposited in the collection of the HNHM, Budapest). Slide No. RL3858 male.

Paratypes: 2 males, with the same data as the holotype (deposited in coll. NEKRASOV, Moscow & G. RONKAY, Budapest). Slide No. RL3831 male.

Diagnosis: *A. peterseni* (CHRISTOPH, 1887) has relatively wide range of variation in its external features. The populations occurring in the different parts of the Asian mountain systems (Elburs, Kopet-Dagh, Hissar, Pamir, Tien Shan, Hindukush) are more or less separable, most specimens of a certain population can be distinguished from those of the other populations, but, due to the smaller or larger overlaps in their external morphology, these populations are hardly separable by using "key features". The population of the Arax valley has, however, a curious external appearance, supporting its distinction at subspecific level. *A. p. nekrasovi* is smaller in size (wingspan 33–34 mm, length of forewing 15–16 mm), its forewings are rather short but high. The ground colour is ochreous slate-grey with ochreous-bronze shining. The wing pattern is less distinct, the postmedial crossline is less oblique, without stronger dark definition at outer side, there-

fore the crossline seems as a bit arcuate, not straight, oblique as in all other populations of *A. peterseni*. The streak of submedian fold is short, rather pale, the medial area is narrow, the antemedial and postmedial crosslines are fused below



Figs 19–25. 19–20 = *Auchmis mongolica expallescens* ssp. n., male genitalia, paratype; 21–22 = *A. peterseni nekrasovi* ssp. n., male genitalia, holotype; 23 = *Nekrasovia sinica* sp. n., female genitalia, holotype; 24 = *N. crassicornis* BOURSIN, female genitalia, Tadjikistan; 25 = *N. pliuschi* RONKAY et VARGA, female genitalia, Kirghisia

submedian fold, this feature is very unusual in this species. The orbicular and reniform stigmata are rounded, relatively big, their outlines incomplete. The hind wing is shining, slightly transparent white, much more whitish than usual in *A. peterseni*, the wide marginal suffusion is strong, dark, contrasty, the transverse line is rather diffuse but present. The male genitalia of the new subspecies (Figs 21, 22) show no significant differences comparing with those of the other populations of *A. peterseni*.

Description: wingspan 33–34 mm, length of forewing 15–16 mm. Head, collar and tegulae pale ochreous grey, mixed with brownish, frons, collar, edges of tegulae and thoracic tufts marked with greyish brown, antenna of male very shortly ciliate. Forewing rather short, ground colour ochreous slate-grey with ochreous-bronze shining, irrorate with grey and ochreous brown, marginal area suffused with somewhat darker grey. Wing pattern more or less distinct, crosslines double, antemedial strongly, postmedial only slightly sinuous, latter less oblique, without stronger dark definition at outer side, its upper part arcuate. Streak of submedian fold (basal dash) short, medial area narrow, ante- and postmedial crosslines fused below submedian fold. Orbicular and reniform stigmata rounded, relatively big, their blackish outlines incomplete, filling ochreous-whitish. Subterminal line indistinct, strongly sinuous, whitish grey, marked with fine black lines between veins and dark outer part of marginal area. Terminal line fine, blackish, cilia whitish, striolate with ochreous grey. Hindwing shining, slightly transparent white, veins only slightly darker, marginal suffusion wide, strong, dark brown. Discal spot missing or hardly visible, terminal line darker brown, cilia white. Underside of wings ochreous white, forewing with stronger, hindwing with weak pale greyish irroration; discal spots rather strong, transverse lines represented by rows of small dots.

Male genitalia (Figs 21, 22): Uncus very long, slender, curved, tegumen moderately high, penicular lobes very small. Fultura inferior small, basal part trapezoidal, apical process long, fultura superior large, finely sclerotized; vinculum short, U-shaped. Valva large, elongated, distally dilated, costa with fine triangular lobe at middle, ventral margin with rounded subapical lobe. Cucullus broad, triangular with apex pointed, corona very long. Sacculus short, rounded, clavus reduced, harpe large, flattened, claw-like, with serrate dorsal edge, ampulla fine, narrow, arcuate. Aedeagus long, cylindrical, finely arcuate, carina with large, granulose dorso-lateral plates. Vesica broadly tubular, upturned, distally tapering, strongly scobinate.

Bionomics and distribution: *A. peterseni* is one of the most widespread species of the genus, its area extending from N Turkey to the eastern Hindukush Mts, where it occurs sympatrically with *A. indica* (WALKER, 1865). The new subspecies represents a peripheric isolate in the valley of the river Arax, northwards from the main chain of the Elburs Mts. *A. p. nekrasovi* lives in semi-desert habitats, the specimens were collected in August. As the other populations may also have a partial second brood in August–October (the first, main brood is in April–June), the new subspecies presumably has also two generations.

Etymology: The new subspecies is dedicated to Mr A. V. NEKRASOV (Moscow).

Nekrasovia sinica sp. n.
(Figs 11, 12, 23)

Holotype: Female, China "Tapaishan im Tsinling, Sued-Shensi. Ca. 1700 m, 4.9.1936. H. Höne" (red label), slide No. RL4442 female. Deposited in the collection of the Zoologisches Forschungsinstitut und Museum Alexander Koenig, Bonn (AKM).

Paratype: Male, Tapaishan im Tsinling, Sued-Shensi. Ca. 3000 m, 19.8.1936. H. HÖNE (coll. AKM, Bonn). The abdomen of the specimen is missing.

Diagnosis: The new species is externally similar to *N. crassicornis* (BOURSIN, 1960) and *N. pliuschi* RONKAY et VARGA, 1993, but the forewing is narrower with less pointed apex, the ground colour is pinkish brown, not bluish-grey, the forewing pattern is significantly sharper, the crosslines and the stigmata are dark brown, contrasting, the inner area of the hindwing is paler, the discal spot and the transverse line stronger, well-discernible, the pectination of the male antenna is with somewhat shorter branches. The female genitalia of *N. sinica* differ from those of *N. crassicornis* and *N. pliuschi* (Figs 24, 25) by the larger, broader, more calyculate ostium bursae, significantly longer, broader, more sclerotized ductus bursae, larger, more gelatinous but less sclerotized cervix bursae, projected caudally.

Description: Wingspan 36–38 mm, length of forewing 17–18 mm. Head and thorax pale brown with fine pinkish shade, mixed with a few dark grey and brown hairs, lateral sides of palpi dark grey-brown. Antenna of male widely bipectinate, that of female filiform, very shortly ciliate. Forewing elongated, broader in male, narrow in female, apex pointed, outer margin finely crenulate. Ground colour ochreous brown with fine pinkish suffusion and some slate-grey irroration; veins covered with dark brown scales. Wing pattern rather sharply defined, antemedial and postmedial crosslines double, dark brown, defined with ochreous scales, former oblique, latter evenly arcuate around cell, both strongly sinuous. Streak of submedian fold (basal dash) long, fine, blackish, subbasal line represented by its costal streak, medial line narrow, diffuse, dark brown stripe. Subterminal shadow-like, dark red-brownish, defined by pale ochreous zone. Stigmata present, outlines of orbicular and claviform complete, blackish, reniform partly encircled with blackish brown lines. Terminal line ochreous, marked with row of dark triangles, cilia as ground colour. Hindwing whitish-ochreous, inner area slightly, narrow marginal field strongly suffused with pale brownish. Veins somewhat darker, discal spot and transverse line well-discernible. Terminal line interrupted, fine, dark brown, cilia ochreous with darker brown stripe. Underside of wings shining whitish-ochreous, inner area of forewing with stronger, other parts of wings with scarce brownish irroration; discal spots diffuse but well-marked, transverse lines variably strong, continuous or interrupted.

Female genitalia (Fig. 23): Ovipositor conical, elongated, papillae anales less sclerotized, gonapophyses moderately long. Ostium bursae relatively broad, calyculate, sclerotized, connected with ductus bursae with short, membranous neck. Ductus bursae medium-long, more or less flattened, posterior two-thirds sclerotized, partly folded, anterior third gelatinose. Cervix bursae large, more or less discoidal, most parts gelatinous, not sclerotized, corpus bursae elongated-elliptical, membranous, with four long, ribbon-like signa.

Male genitalia: Unknown.

Etymology: sinicus = Chinese.

* * *

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NEW SPECIES OF THE CONISANIA SUAVIS (STAUDINGER, 1892) SPECIES-GROUP (NOCTUIDAE, HADENINAE)

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Descriptions of two new species of the *Conisania suavis* (STAUDINGER, 1892) species-group, *C. clara* sp. n. (China, Kuku-Noor; Sechuan) and *C. dentirena* sp. n. (China, E Tibet) are given, with the discussion on the taxonomy and biogeography of the Himalayan–Tibetan *Conisania* species. With 14 figures.

Key words: *Conisania*, Noctuidae, new species, Himalayan–Tibetan region

INTRODUCTION

A taxonomic and biogeographical survey of the *Sideridis* HÜBNER, [1821]1816 genus-group, including the genus *Conisania* HAMPSON, 1905, was provided by VARGA & RONKAY (1991), containing the characterization of some species-groups of *Conisania*. Part of this paper is devoted to the detailed comparison of the two known species of the *C. suavis* species-group and the externally similar *Sideridis unica* (LEECH, 1889) and *S. unica suavina* (DRAUDT, 1950).

The subsequent studies of the HÖNE material have revealed the fact that the specimens described by DRAUDT as "*suavis* f. *suaveola*" are conspecific with *C. discestroides* VARGA et RONKAY, 1991, representing two distinct geographic races of the same species. As this taxon was described as a "form" before 1961, according to the rules of the ICZN (45 g), the name "*suaveola* DRAUDT, 1950" is acceptable for the species and its nominotypical Chinese subspecies, while *discestroides* can be used for the Mongolian taxon.

The recent examination of the new expedition materials originating from the Himalayan–Tibetan region and from Central Asia led to the discoveries of several new *Conisania* species. Some of them have already been described (*C. lahoulicola* HACKER et VARGA, 1990, *C. verhulsti* GYULAI et RONKAY, 1995) or are under description (YOSHIMOTO 1997, HREBLAY & RONKAY 1997).

The investigations of the Hadeninae sections of some historical collections (PÜNGELER, HÖNE) and new materials of Noctuidae from the Tibetan plateau and the surrounding high mountain regions have resulted in the discovery of further two species of the *C. suavis* species-group. These two species are the sister-species of the formerly known taxa, the species occurring in the NE edge of Tibet is the sibling of *C. suaveola* while the eastern Tibetan new species is closely allied to *C. suavis*. The descriptions of the two species, with the identification key for the male genitalia of the members of the *C. suavis* species-group, are given below.

The holotype deposited in coll. P. GYULAI is available for study through the Hungarian Natural History Museum, Budapest.

Synopsis of the *Conisania suavis* species-group

C. clara **sp. n.** (Kuku-Noor)
C. suaveola DRAUDT, 1950, **stat. rev.**
C. suaveola discestroides VARGA et RONKAY, 1991, **stat. n.**
C. suavis (STAUDINGER, 1892)
Conisania dentirena **sp. n.**

The general characterization of the external and genital features of the species-group is given by VARGA & RONKAY (1991). Suffice here to mention that the shape and size of the saccular extensions, a synapomorphic feature of the species-group, proved to be characteristic for all members of the *suavis*-group. These saccular extensions are strongly dissymmetrical, displaying also obvious specific differences (see Figs 5–12, 14).

IDENTIFICATION KEY FOR THE MALE GENITALIA

1 (4) Dorsal plate of carina bearing a large, peaked, sclerotized crest

2 (3) Fultura inferior much larger, higher, ventral plate with long apical process, aedeagus also considerably longer, narrower, neck of cucullus broader, dorsal arm of vesica bearing two small diverticula **clara** sp. n.

3 (2) Fultura inferior much smaller, lower, ventral plate without apical process, aedeagus considerably shorter, thicker, neck of cucullus narrower, dorsal arm of vesica bearing only a single diverticulum *suaveola* and *discestroides*

4 (1) Dorsal plate of carina without sclerotized crest

5 (6) Vesica with a medium-long, thorn-like basal cornutus; cucullus larger, with longer neck, right saccular extension with much stronger, more acute inner peak, fultura inferior larger, stronger *suavis*

6 (5) Vesica without basal cornutus, cucullus small, without well-expressed neck, inner peak of right saccular extension smaller, less acute, fultura inferior smaller **dentirena** sp. n.

Conisania clara sp. n.
(Figs 1, 5, 6, 14)

Holotype: male, [China], "TIBET (Kuku-Noor)", "suavis ♂, v. R. Tancré, 5.05." (underside of the locality label). Slide No. 8384 M. HREBLAY. Deposited in the collection of the Museum für Naturkunde, Humboldt-Universität, Berlin.

Paratype: 1 male, China, "Tapaishan im Tsinling, Sued-Shensi, ca. 3000 m, 3.7.1936, H. Höne", coll. HÖNE (Alexander Koenig Museum, Bonn). Slide No. Hö 20\V 40 VARGA.

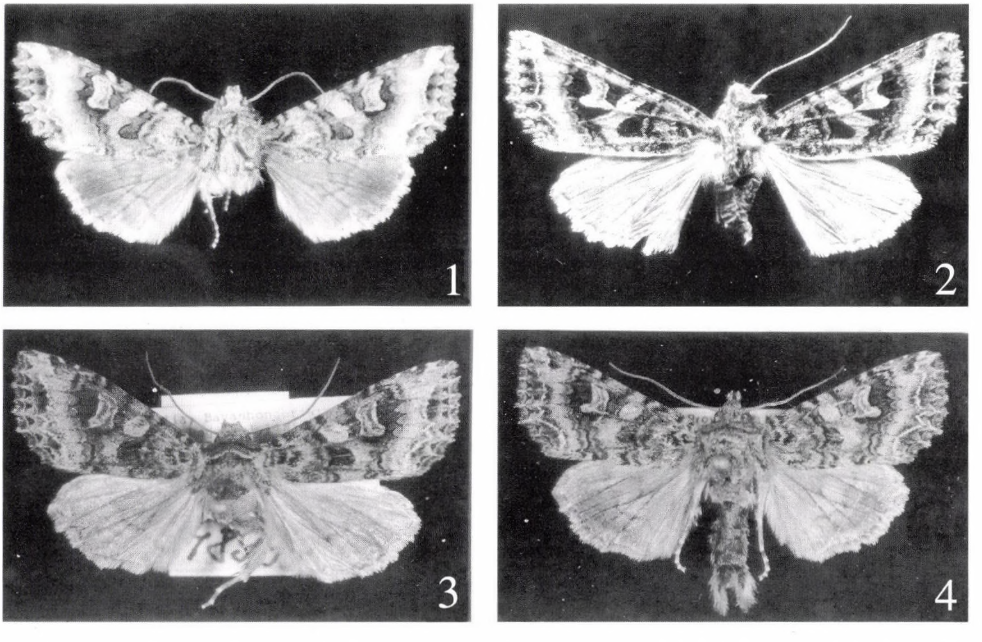
Diagnosis: The new species is the sister species of *C. suaveola*. *C. clara* differs from its sibling by its much paler colouration with less intense darker irroration, especially in basal and marginal areas. Inner half of marginal area broader, clear, orbicular and reniform stigmata larger, their filling also paler, the suborbicular patch is more conspicuous. In the male genitalia of the new species both plates of the fultura inferior are considerably larger, higher, the valva is broader, the neck of cucullus is significantly broader, the peak of the right saccular extension is much smaller. The aedeagus is about one and the half as long as in *C. suaveola*, the dorsal arm of the vesica is narrower, bearing two small diverticula (*C. suaveola* has only one), the cornuti fields are consisting of smaller spinules.

C. clara differs from the members of the other lineage of the group, *D. suavis* and *D. dentirena*, resp., by its generally lighter colouration with less variegated forewing pattern, broader, paler orbicular and reniform stigmata and inner part of marginal field. The major difference in the male genitalia, besides the shape and size of the valva, the cucullus and the saccular extension, is the presence of the large dorsal tooth on the carina which is missing in the *D. suavis*-line.

Description: Wingspan 38 mm, length of forewing 17 mm. Head and thorax pale pinkish brown, mixed with some violaceous grey and blackish, sides of palpi, frons, edges of collar, tegulae and thoracic tufts marked with blackish brown. Antennae of male finely ciliate. Forewing elongated, relatively high, with apex pointed, outer margin finely crenulate. Ground colour pale pinkish brown with a fine violaceous shade, costal area irrorated with grey, medial area with darker tobacco-brown. Wing pattern well-defined, subbasal, ante- and postmedial lines double, sinuous, dark brown, marked with some blackish, filled with ground colour. Medial line narrow, diffuse, dark brown, subterminal continuous, whitish-ochreous, forming a W-mark between veins m3–cu2,

defined by a dark tobacco-brown zone at outer side. Medial field narrow, strongly constricted to inner margin. Stigmata present, large, encircled with fine blackish brown. Orbicular oblique, quadratic, reniform elliptical, constricted at middle, both filled with ground colour. Suborbicular patch less conspicuous, smaller than orbicular stigma, claviform rounded, filled with dark tobacco-brown. Inner half of marginal area broad, patternless, slightly violaceous. Terminal line a row of sharp, black triangles, cilia pinkish brown, finely striolate with ochreous. Hindwing similarly pinkish brown, veins, discal spot, transverse line and wide marginal area darker brown. Terminal line a row of brown arches, cilia ochreous, with darker medial line. Underside of wings pale pinkish-ochreous, irrorated with grey-brown, inner area of forewing with stronger brownish suffusion. Transverse line rather sharply defined, sinuous on both wings, discal spot of hindwing strong, moon-shaped, that of forewing a diffuse, dark patch.

Male genitalia (Figs 5, 6, 14): Uncus short, acute, cuneate, tegumen very low, wide, penicular lobes small, rounded triangular, setose. Fultura inferior double, ventral plate smaller, deltoidal with rounded angles, dorsal plate large, high, more or less quadratic, medially folded; vinculum short, strong, V-shaped. Valva broad, apically tapering, ventral margin strongly convex, costa with a tetraedric prominence at base of cucullus. Cucullus small, more or less triangular, sclerotized, apex pointed, corona consisting of a few sparse rows of strong setae. Sacculus large, clavus small, peaked, saccular processi strongly asymmetric, very large, rounded, finely peaked inwards on right side, much smaller, less sclerotized, quadratic on left valva. Harpe reduced to its basal bar, pulvillus strong, rounded, ampulla absent. Aedeagus long, cylindrical, arcuate, carina with strong dorsal tooth. Vesica generally T-shaped, basal tube broad, with a rounded distal diverticulum, dorsal arm a long, narrow, tubular diverticulum, terminated in a bundle of fine spines, medial part with two small, rounded lateral diverticula. Ventral arm terminated in ductus ejaculatorius, its distal part inflated, globular, armed with a long, narrow field of long, fine spinules.



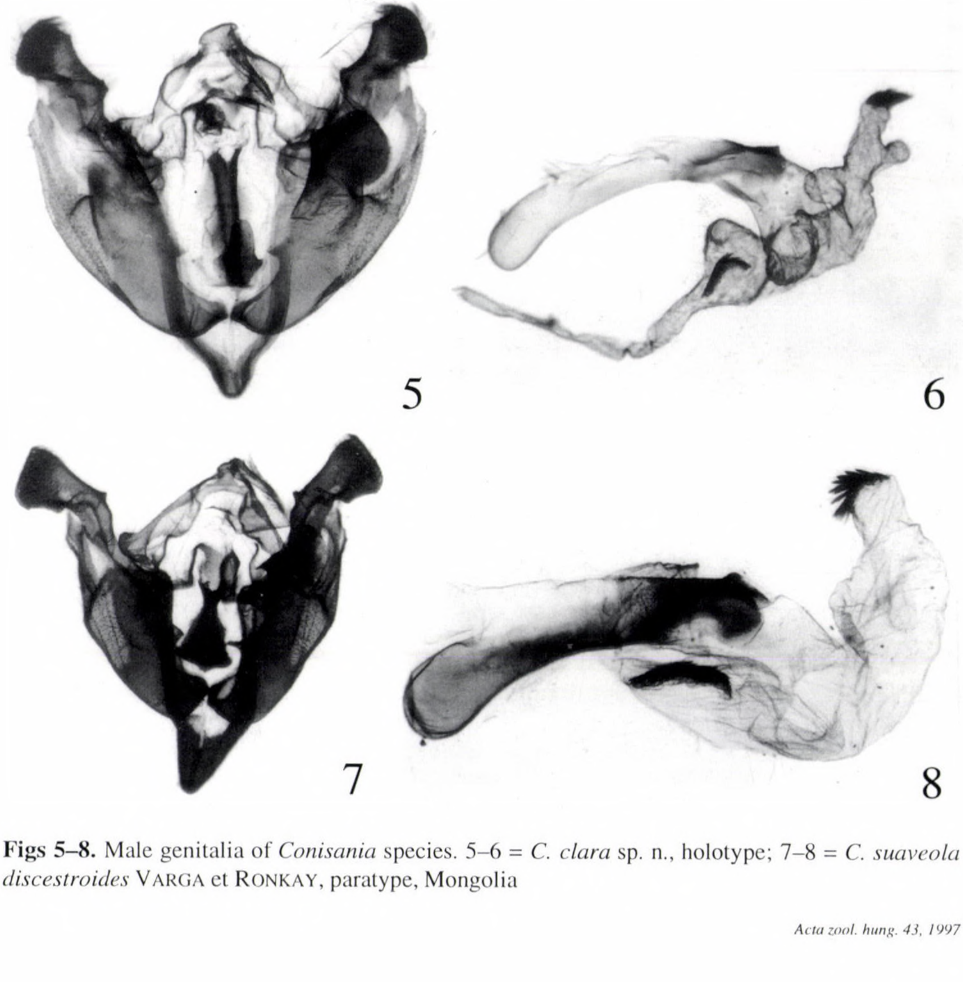
Figs 1–4. 1 = *Conisania clara* sp. n., holotype male; 2 = *C. dentirena* sp. n., holotype male; 3 = *C. suaveola discestroides* VARGA et RONKAY, holotype male, Mongolia; 4 = *C. suavis* (STAUDINGER), male, Korea

Bionomics and distribution: The two known specimens of the species were collected along the eastern border of the Tibetan plateau, the two localities are rather remote from each other. The holotype was collected by TANCRÉ at the early spring period.

Conisania suaveola (DRAUDT, 1950) **stat. rev.**

Type material examined: two male, one female syntypes, China, Mien-Shan, one of the males is designated here as lectotype. Lectotype: male, "Mien-shan (Prov. Shansi), obere Höhe ca. 2000 m, 30.7.1937, H. Höne", "Gen. Prp. 4494 ♂ *Conisania suaveola* Drdt. b. spec., China/Shansi Behounek det. 1990" (coll. AKM, Bonn). Paralectotypes: 1 female, with the same data as lectotype, slide No. 4508f BEHOUNEK; 1 male, from the same locality, 31.7.1937, H. HÖNE (both in coll. AKM, Bonn).

Taxonomic notes. The specific identity of the syntypes of *C. "suavis f. suaveola"* and *C. discestroides* was stated firstly by BEHOUNEK who made the dissection of the best specimen of *suaveola*. The two, geographically well iso-



Figs 5–8. Male genitalia of *Conisania* species. 5–6 = *C. clara* sp. n., holotype; 7–8 = *C. suaveola discestroides* VARGA et RONKAY, paratype, Mongolia

lated populations of the species differ by the coloration and the intensity of the noctuid pattern of the forewings (the ground colour is more violaceous in case of *discestroides* and the dark, blackish brown pattern is stronger but more diffuse), the genitalia of the two subspecies show no significant differences.

The large series of *suaveola* from the Mien-Shan, mentioned by DRAUDT (1950: 32) ("Die zahlreichen Stücke von Mien-shan..." has probably been destroyed during the World War Two, including the "Type" which DRAUDT certainly had chosen and labelled; only the above-mentioned three specimens are present in the collection of the AKM, Bonn (STÜNING, pers. comm.).

Conisania suaveola discestroides VARGA et RONKAY, 1991, **stat. rev.**

Taxonomic notes. The taxonomic interpretation of *discestroides* is given under the preceding taxon. An additional female specimen of the Mongolian subspecies was collected in 1997 by PEREGOVITS & LŐKÖS (Mongolia, Central aimag, Ulaan-Baator, Mts Bogd, Zaisan valley, 1700 m, 47°51'48"N, 106°54'01"E, 13.VI.1997, coll. HNHM, Budapest).

Conisania dentirena sp. n
(Figs 2, 9, 11, 13)

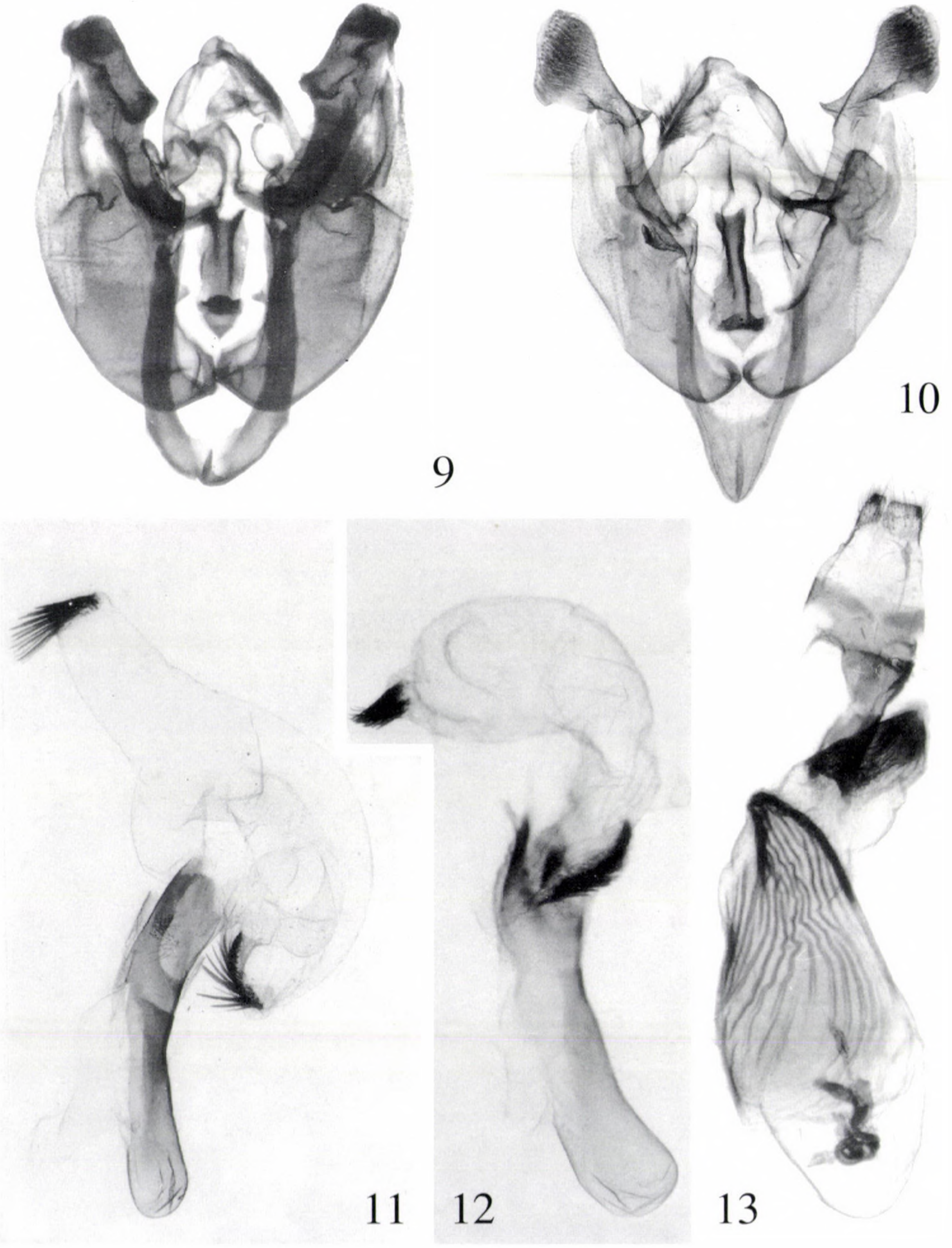
Holotype: male, China, East Tibet, Taba, 3900 m, 18.VI.1996, leg. W. FICKLER, slide No. 723 GYULAI. Deposited in the collection of P. GYULAI (Miskolc, Hungary).

Paratypes: 2 males, 2 females, with the same data as holotype (coll. GYULAI, G. RONKAY and Z. VARGA). 1 female, "A-tun-tse (Nord Yünnan), Talsohle (ca. 3.500 m), 18.6.1936 H. HÖNE"; 1 female, same locality but 3.000 m, 6.7.1937, H. HÖNE (coll. MAK Bonn). Slide Nos. 4507f BEHOUNEK, 5927 RONKAY (females).

Diagnosis: The new species is closely related to *C. suavis*, differing from it by its longer, more pointed forewing, generally less variegated forewing pattern with somewhat stronger crosslines, more sharply defined, clearer stigmata and suborbicular patch. In the male genitalia the valva of *C. dentirena* is broader but shorter, the cucullus is much smaller, without well-expressed neck, the inner peak of the right saccular is smaller, less acute, the fultura is smaller, narrower, the vesica is without basal cornutus etc. The comparison with the other lineage of the species-group is given under the diagnosis of *C. clara* sp. n.

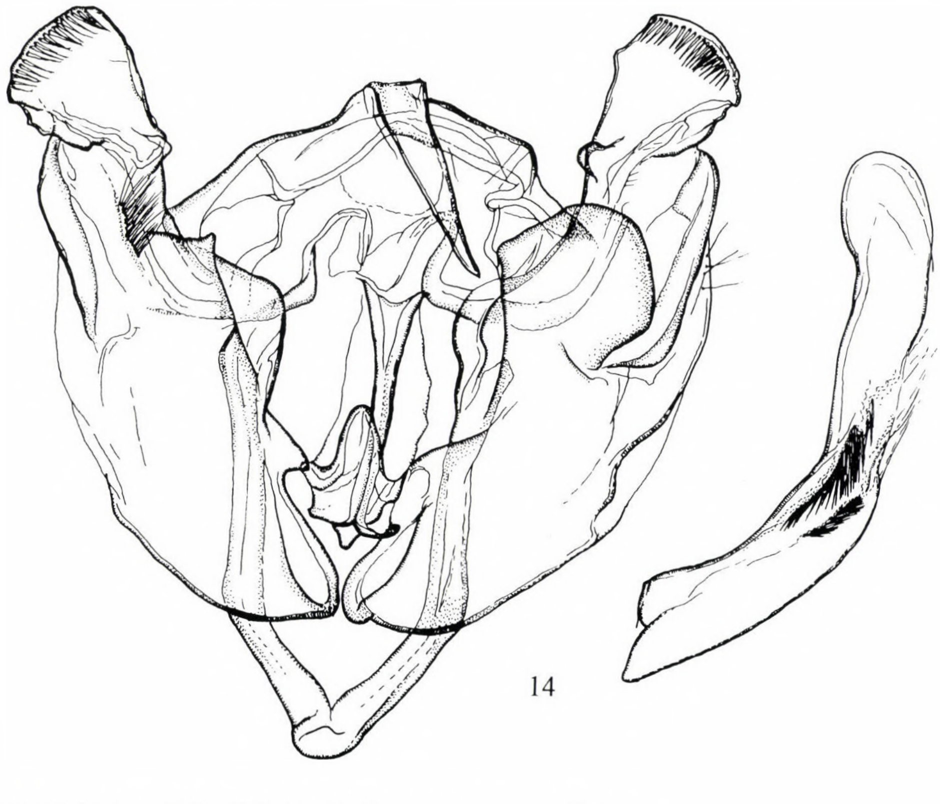
Description: Wingspan 35 mm, length of forewing 17 mm. Head and thorax dark violaceous brown, mixed with some rosaceous grey and blackish, sides of palpi, frons, edges of collar, tegulae and thoracic tufts marked with blackish brown. Antennae of male finely ciliate. Forewing elongated, relatively high, with apex pointed, outer margin finely crenulate. Ground colour dark rosaceous brown with a fine violaceous shade, inner and medial areas irrorated with darker brown.

Figs 9–13. Genitalia of *Conisania* species. 9, 11 = male genitalia of *C. dentirena* sp. n., holotype; 10, 12 = male genitalia of *C. suavis* (STAUDINGER), Russia, Amur valley; 13 = female genitalia of *Conisania dentirena* sp. n., paratype, China, Tibet



Wing pattern well-defined, subbasal, ante- and postmedial lines double, sinuous, dark brown, marked with some blackish, filled with ground colour. Medial line narrow, diffuse, dark brown, subterminal continuous, whitish-ochreous, less waved, W-mark rather flattened, defined by a dark blackish-brown zone at outer side; inner half of marginal area patternless, pinkish-violaceous. Medial field narrow, strongly constricted to inner margin. Stigmata present, large, encircled with fine blackish brown. Orbicular oblique, flattened, reniform elliptical, constricted at middle, with a fine, peaked projection at inner angle; both filled with ground colour. Suborbicular patch conspicuous, slightly longer than orbicular stigma, claviform elongated, large, blackish. Terminal line a row of blackish triangles, cilia pinkish brown, finely striolate with ochreous. Hindwing suffused with brown, inner area somewhat paler, veins, discal spot, transverse line and wide marginal area darker brown. Terminal line dark brown, cilia ochreous, with darker medial line. Underside of wings shining, pale pinkish-ochreous, irrorated with grey-brown, inner area of forewing with stronger brownish suffusion. Transverse line of forewing diffuse, that of hind wing rather sharply defined, sinuous, discal spot of hindwing strong, moon-shaped, that of forewing a diffuse, darker shadow.

Male genitalia (Figs 9, 11): Uncus short, slender, pointed, tegumen very low, wide, penicular lobes small, narrow, rounded triangular, setose. Fultura inferior double, ventral plate small, deltoidal, dorsal plate large, high, more or less quadratic, granulosely sclerotized, with two stronger, apically diverging stripes; vinculum short, strong, U-shaped. Valva broad, apically tapering, ventral margin strongly convex, costa with a strong, wrinkled prominence at base of cucullus. Cucullus small, more or less triangular, sclerotized, apex pointed, ventral margin a strong crest, corona short, surface of cucullus densely setose. Sacculus large, clavus small, peaked, saccular processi strongly



14

Fig. 14. Male genitalia of *Conisania clara* sp. n., paratype, China

asymmetric, large, quadratic, peaked inwards on right side, much smaller, less sclerotized, trapezoidal on left valva. Harpe reduced to its basal bar, pulvillus strong, rounded, left ampulla small, digitiform, right ampulla absent. Aedeagus long, cylindrical, arcuate, carina with sclerotized, smooth dorsal – dorso-lateral plate. Vesica generally T-shaped, basal tube short, with a rounded distal diverticulum, dorsal arm long, rather broad, tubular, terminated in a bundle of long spines, with a large, elliptical diverticulum at its base. Ventral arm broadly tubular, scobinate, terminated in ductus ejaculatorius, armed with a long, narrow field of long, fine spinules at distal end.

Female genitalia (Fig. 13): Ovipositor short, weak, gonapophyses short. Ostium bursae trapezoidal, granulosely sclerotized, ductus bursae short, narrow, sclerotized, laterally folded. Cervix bursae long, conical, with apical third strongly sclerotized, cristate and folded, medial and proximal parts rugose. Corpus bursae elliptical, most parts sclerotized, strongly cristate, posterior end forming an acute tip, fundus rounded, membranous; proximal half with a narrow signum-stripe.

Bionomics and distribution: The specimens were collected in the spring period, at a relatively high elevation in eastern Tibet.

* * *

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COMPARISON OF THE CARABID COMMUNITIES OF A ZONAL OAK-HORNBEAM FOREST AND PINE PLANTATIONS

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Carabid communities of a zonal oak-hornbeam forest (*Querco-Carpinetum*) and plantations (young spruce plantation, old spruce plantation and old black-pine plantation) were analysed in the Aggtelek National Park by pitfall traps. The results suggest that the young plantation has very low diversity for many years after establishment and it is not explained by the food resources. It may be related to microclimatic conditions and especially to the structure of the litter layer and the herbaceous vegetation. The old plantations are re-colonised by the shrubs and herbs of the native vegetation, and as a result the diversity and composition of the carabid communities of these plantations are similar to those communities of zonal forests. This shows that adequate conservation management may have an important contribution to the maintenance of diversity of carabid communities.

Key words: carabid beetles, diversity, plantation, nature conservation, biomonitoring

INTRODUCTION

The exponential increase of human activities has reached the point where Man alters the natural environment on a global scale and thus may endanger the survival of the animals. The most direct cause of this danger is the destruction of their habitats. During the 1950s and 1960s extensive pine plantations were established in the study area which significantly contributed to the destruction of natural habitats, because pine species are not native to that region. Therefore it is very important to monitor changes in local faunas in habitats that are undergoing changes and to compare the composition of the present communities in primeval habitats and their affected surroundings (LENSKI 1982, NIEMELÄ *et al.* 1988, NIEMELÄ 1990, GEORGES 1994).

Changes in the vegetation and soil caused by the establishment of plantations are most probably reflected in the ground-dwelling insect fauna. Carabid beetles (Coleoptera: Carabidae) may be useful indicators of changes in the vegetation since the species show different degrees of habitat selection, ranging from habitat specialists (confined to only one habitat) to habitat generalists (occurring in many habitats) (THIELE 1977). Carabid beetles are highly diversified, they are

sensitive to abiotic and biotic factors, and their ecology and systematics are relatively well known. All these facts make carabids and their communities potentially good biological indicators of environmental changes (LOREAU 1994).

Our study was aimed at the ecological analysis of the carabid communities of a zonal oak-hornbeam forest (*Querco-Carpinetum*), and pine plantations which were planted after clear-cutting in an area of the same kind of oak-hornbeam forest, with particular reference to the diversity of these communities.

MATERIAL AND METHODS

Study area and sampling

The study area is located in the north–east Hungary in the Aggtelek-Karst. The area is part of the Aggtelek National Park, and is found in the in the buffer zone of the central part of an UNESCO MAB Biosphere Reserve. In this region the zonal forest association is oak-hornbeam (*Querco-Carpinetum*), which is the most extensive one in the area. The study site was divided into 4 groups: (1) oak-hornbeam forest as control (2) young spruce plantation (about 10–15 years old) (3) old spruce plantation (about 35–40 years old) (4) old black-pine plantation (about 35–40 years old). All the plantations were planted after clear-cutting the oak-hornbeam forests. Both in the old spruce and in the black-pine plantations, shrubs and trees characteristic of the zonal forest, grew. In the old spruce habitat, hornbeam and oak trees appeared as mixed trees. In the black-pine plantation only rich herbaceous and shrubby vegetation were found, without any hornbeam and oak trees in the canopy layer.

In each habitat 18 pitfall traps were used during the sampling procedure. In order to sample habitat heterogeneity, pitfall traps were arranged in 3 separate groups containing 6 traps in each habitat. The traps contained ethylene-glycol as a killing-preserving solution. Trapped individuals were collected monthly (NIEMELÄ *et al.* 1990) from April to October in 1995. All carabid beetles taken in pitfall traps were identified to species using standard keys (FREUDE *et al.* 1976). We identified not only the carabid beetles, but to certain taxonomic levels also other animals that fell into the traps. We wanted to find out whether the differences in the diversity of carabid communities are to be explained by the variability of the potential food resources (NIEMELÄ 1990, NIEMELÄ *et al.* 1985).

Data analyses

Similarity of the species composition was calculated by the Bray-Curtis dissimilarity index, and the similarity structure was analysed by Principal Coordinates Analysis (GORDON 1981). The NuCoSA package (TÓTHMÉRÉSZ 1993*b*) was used for the computations.

Two traditional diversity indices were used: SHANNON's and SIMPSON's (e.g. PIELOU 1975). We also calculated the effective number of species, based on the SHANNON diversity. This is the number of species which would have the same diversity if they were all equally frequent.

Diversity profiles were used for scale-dependent diversity characterization. We used the RÉNYI diversity index family because it was reported to provide good results for communities of all sizes (TÓTHMÉRÉSZ 1995). Diversity profiles were calculated by the DivOrd package (TÓTHMÉRÉSZ 1993*a*). Statistical tests of the difference in diversity of the compared communities were based on the normal approximations published by TONG (1983) for both the SHANNON and the SIMPSON indices of diversity, and the RÉNYI diversity index family.

RESULTS

Composition of the carabid communities of old spruce plantation and of the zonal forest were similar to each other, and the carabid communities of both the young spruce and the black-pine plantation differed considerably from the two above communities (those of old spruce plantation and zonal forest). The carabid communities of the young spruce and the black-pine plantation were also different (Fig. 1).

The number of species was the highest in the zonal oak-hornbeam forest and it decreased in the following order:

Zonal forest > Young spruce plantation = Old spruce plantation > Black-pine plantation.

As regards the order for the effective number of species, the SHANNON and the SIMPSON indices of diversity resulted in the following (Table 1):

Zonal forest ≈ Old spruce plantation >> Black-pine plantation ≈ Young spruce plantation.

Difference in diversity between the communities of the zonal forest and old spruce plantation, and the difference between the communities of black-pine and young spruce plantation were not significant, whereas the other differences in diversity were significant ($p<0.01$).

It is clear from ordering the RÉNYI diversity indice that the carabid communities of the zonal oak-hornbeam forest and the old spruce plantation cannot be ordered based on their diversity, because the diversity profiles intersect each other. The same is valid for the communities of the old spruce and young spruce plantations, and for those of the young spruce and black-pine plantations (Fig. 2). By increasing the value of the scale parameter it may be pointed out that the diversity profiles of the communities of old spruce and black-pine plantation, and the communities of zonal forest and black-pine plantation also intersect each other. But the community of the zonal oak-hornbeam forest was significantly ($p<0.01$) more diverse than the community of the young spruce plantation.

Table 1. Diversity statistics of the studied carabid communities

	Zonal forest	Young spruce plantation	Aged spruce plantation	Black pine plantation
Number of species	19	17	17	14
Effective number of species	5.7	3.7	5.6	4.6
Number of individuals	1199	203	828	427
SHANNON diversity	1.7471	1.2987	1.7188	1.5308
SIMPSON diversity	0.7243	0.5066	0.7503	0.6908

Table 2. The number of taxons and individuals of the potential prey groups of carabid

	Zonal forest	Young spruce plantation	Aged spruce plantation	Black pine plantation
Number of taxons	13	16	16	15
Number of individuals	4857	3906	3038	3756

The number of the animal groups that may serve as food for carabids decreased in the following order:

Young spruce plantation = Old spruce plantation > Black-pine plantation > Zonal forest.

The number of individuals was the highest in the zonal oak-hornbeam forest while in the plantations these numbers were close to each other (Table 2).

Diversity profiles of the potential carabid prey groups of the carabid beetles of the plantations intersect each other but all the groups of potential food were significantly ($p<0.01$) more diverse than the food resources of the zonal oak-hornbeam forest (Fig. 3).

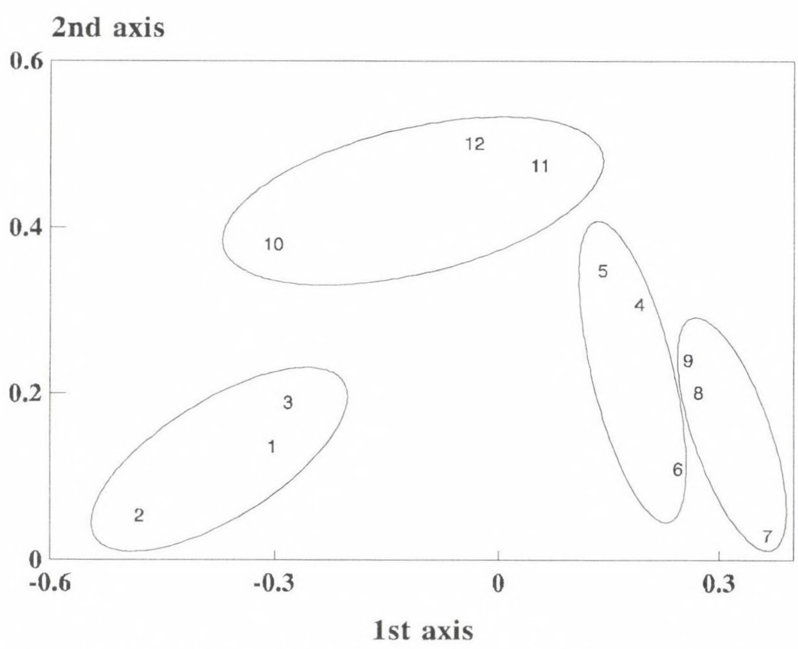
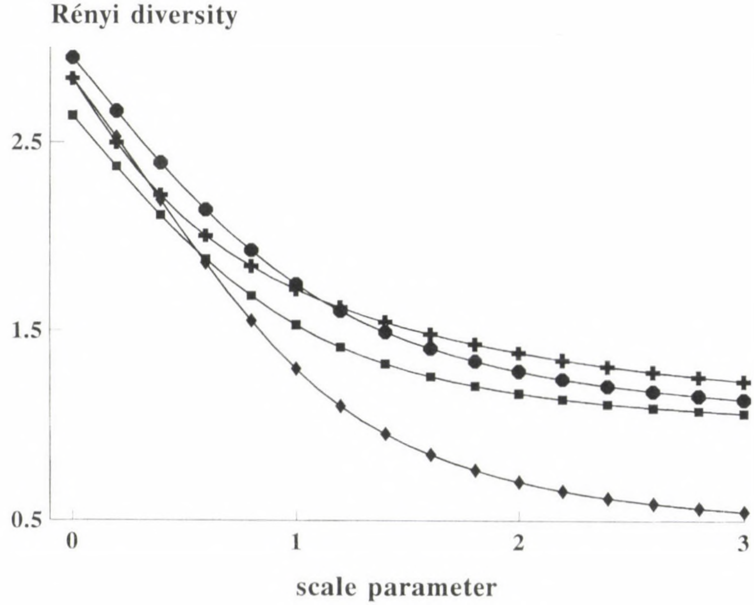


Fig. 1. Ordination of the studied carabid communities by Principal Coordinates Analysis; the Bray-Curtis similarity index was applied. 1–3 = young spruce plantation; 4–6 = old spruce plantation; 7–9 = *Querco-Carpinetum*; 10–12 = black pine plantation

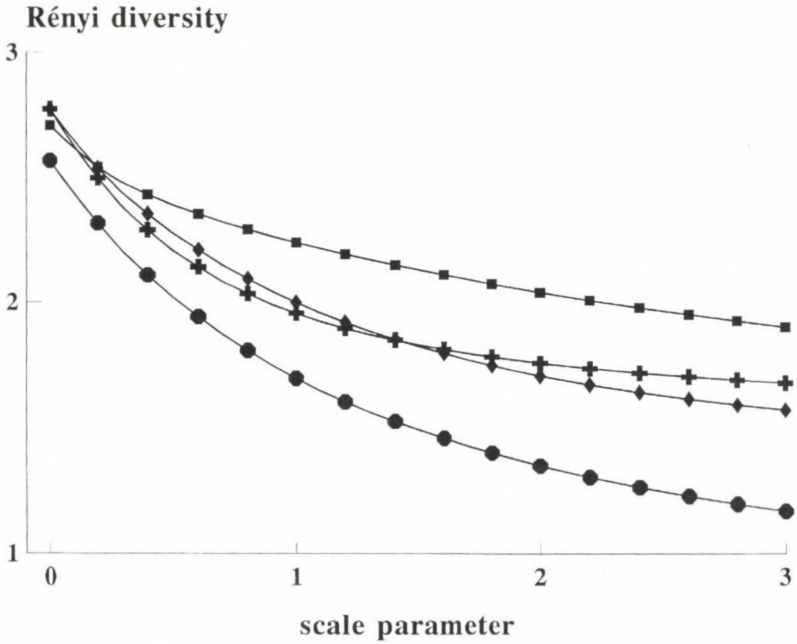
Fig. 2. Diversity profiles of the carabid communities by the RÉNYI diversity index family. Scale parameter controls the contribution of the species to the diversity of the community. For a small scale parameter value the rare species have a strong influence, whereas for large scale parameter values they are ignored. ● : zonal forest, ◆ : young spruce plantation, ✚ : old spruce plantation, ■: black-pine plantation



DISCUSSION

Composition of the carabid communities of old spruce plantation and the zonal forest were similar to each other, and the carabid communities of both the young spruce and the black-pine plantation differed quite a lot from the above two communities. The carabid communities of the young spruce and the black-pine plantation were also different (Fig. 1). It may be explained by the structure of the vegetation of the habitats. It is almost entirely indifferent for the carabid beetles what kind of plants are present in the higher layers of the vegetation, if the density, height, and cover of the layers are similar. In the old spruce plantation these characteristics of the vegetation were similar to those observed in the zonal oak-hornbeam forest. The acidic effect of the fallen pine needles may also be an important factor on the dispersal of carabids. Because of the mixed trees, however, broad leaves were much more dominant at ground level of the old spruce plantation than the pine needles. The young spruce plantation was extremely thick; thus, at ground level a continuous thick layer of pine needles was dominant. This layer was covered in a few places by moss patches, which may indicate the first stage of a secondary succession. In the tree layer of the black-

Fig. 3. Diversity profiles of the potentional prey groups of the carabid beetles based on the RÉNYI diversity index family. ● : zonal forest, ◆ : young spruce plantation, ✚ : old spruce plantation, ■: black-pine plantation



pine plantation only pine trees were found but the herbaceous and shrubby vegetation was rich in native species.

Although there is much debate about the usefulness of diversity indices, it is still one of the most important ecological characteristic of communities. Diversity plays an important role in ecology and in ecological theories, and it is often adopted to characterize the state of ecological systems and is frequently used in monitoring. Various numerical diversity indices, however, may produce different orderings of the communities by diversity (see Table 1). This is due to the statistical features of the diversity indices. The SHANNON index of diversity is more sensitive to the rare species than the SIMPSON index of diversity, which tends to emphasize the dominant species. A solution is available through the diversity profiles, which produce a scale-dependent diversity characterisation; sometimes these techniques are mentioned as diversity ordering, because they produce a partial order of the communities (PATIL & TAILLIE 1982, TÓTHMÉRÉSZ 1993*a*, 1995).

Diversity ordering can be performed by using a diversity index family, which has a scale parameter. The scale parameter is related to the abundance-dominance structure of the community. At different values of the scale parameter the function is sensitive to rare, abundant and frequent species. This way we can

compare the communities concerning the spectrum of frequencies from the point of view of diversity. According to this, one of the communities is more diverse than the other if it is more diverse across the whole range of the scale parameter. When the diversity profiles cross each other, the communities cannot be ordered according to their diversity, because one of them is more diverse for the rare species, but the other one for the frequent ones. RÉNYI diversity is sensitive to the rare species for small values of the scale parameter, whereas it is sensitive to the abundant species for larger values of the scale parameter.

It is clear from the diversity profiles (Fig. 2) that the carabid community of the zonal oak-hornbeam forest was significantly ($p<0.01$) more diverse than the community of the young spruce plantation, whereas the other communities cannot be ordered according to their diversity because the diversity profiles intersect each other. Diversity of the young spruce plantations and the diversity of the old spruce plantation are almost identical for the rare species (around the zero scale parameter value), whereas they are significantly different for the dominant species (for the scale parameter values >2.0). Both the SHANNON and the SIMPSON indices of diversity are included in the RÉNYI diversity index family. When the value of the scale parameter is equal to 1, than the SHANNON diversity is calculated, whereas when the value of the scale parameter is equal to 2, it is related to the SIMPSON diversity. Therefore it can be seen clearly that the zonal forest is more diverse than the old spruce plantation as calculated by the SHANNON index, whereas the old spruce plantation is more diverse using the SIMPSON index of diversity than the zonal forest (see Fig. 2).

Studying diversity is a useful method of environmental assessment and qualification of natural communities. Reliable diversity comparisons can be obtained by scale-dependent diversity characterisation through diversity profiles, which should be preferred instead of classical diversity indices.

Felling the zonal forest and planting non-native species in the clear-cut area causes dramatic changes in the structure and composition of carabid communities. Changes can be found both in the species spectrum and in diversity. In the old plantations, where native shrubs and trees were let to grow, the carabid community became more and more similar to the community of the original plant association.

MADER's (1986) research supports our results as he pointed out that significant changes in the vegetation were accompanied by drastic changes in the composition of the carabid fauna. NIEMELÄ (1990) also pointed out that the impoverishment of vegetation causes a decrease in the diversity of the carabid community. SZYSZKO (1986) also claimed that radical changes can be experienced in the carabid fauna after clear-cutting and following the establishment of plantations. Only gradual regeneration of the carabid communities can be observed during the growth of the plantation.

We also sampled animals that may serve as food for carabid beetles (SERGEEVA 1994) as they also move on the ground (LOREAU 1988). Diversity profile of the potentional prey group of the carabids in the young spruce plantation was significantly more diverse ($p<0.01$) over the whole range of the scale parameter than the groups of potential food of the zonal oak-hornbeam forest (Fig. 3). Therefore, the differences found in the diversity of the carabid communities of the zonal forest and the young spruce plantation cannot be explained by the variability of the potential food resources. The differences may be caused by other environmental factors or some kinds of biotic or trophic effects. The composition of the vegetation, its density and cover may be key factors (ŠUSTEK 1992, 1994). Light condition, temperature, humidity, structural condition and *pH* of the soil may be relevant environmental factors (PAJE and MOSSAKOWSKI 1984, TRAUTNER 1992); and intra- and interspecific competition might be biotic or trophic effects (LENSKI 1982, 1984, MÜLLER 1986, 1987, LOREAU 1986, 1990*a,b*).

The carabid communities of the young plantations have low diversity, even many years after establishment and it is not explained by food resources, because they are as abundant and diverse as in the other habitats. It may be related to microclimatic conditions and especially to the structure of the litter layer and herbaceous vegetation. In the old plantations, where the shrubs and herbs of the native vegetation are present, the diversity and composition of the carabid communities are similar to the communities of zonal forests.

Monitoring human-influenced, degraded habitats is essential as it includes early observation of structural changes, re-arrangement of the community, degradation and run-away processes. It may also contribute to the success of operative nature conservation management. Moreover, observations on the regeneration and succession of such communities may provide useful information for management plans. In these areas adequate nature management and/or forestry practices play a crucial role treatment in the maintenance of the diversity of carabid communities. Well-established plans, based on firm ecological knowledge, is inevitable to facilitate the process of regeneration, which may again result in natural or at least natural-like habitats.

* * *

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EFFECTS OF POPULATION SIZE AND HABITAT FRAGMENTATION ON THE GENETIC VARIABILITY OF PARNASSIUS MNEMOSYNE POPULATIONS IN NE HUNGARY

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The European range of distribution of *Parnassius mnemosyne* (LINNAEUS, 1758) has been strongly regressing. This process has often resulted in isolates which have become endangered. In Hungary both fairly abundant populations and small isolates of this species occur. The aim of this study was to reveal the pattern of genetic differentiation among *Parnassius mnemosyne* populations in NE Hungary. Population size and structure was investigated by mark-release-recapture method. Genetic differentiation was studied by means of horizontal gel electrophoresis at eight enzyme loci, of which three proved to be polymorphic. The results showed that (i) population size and habitat structure strongly influenced genetic differentiation among the populations; (ii) genetic drift proved to be the main evolutionary force affecting small populations, (iii) while large populations were found to be quite stable and their genetic differentiation showed geographic pattern.

Key words: *Parnassius mnemosyne*, genetic drift, geographical pattern, enzyme electrophoresis, capture-recapture, Hungary

INTRODUCTION

Parnassius mnemosyne (LINNAEUS, 1758) is a highly endangered butterfly species in most part of central and northern Europe (HEATH 1981), and is listed by the Bern Convention. In Hungary, it still occurs in abundant populations but several of them are isolated and at least potentially threatened, therefore included in the Hungarian Red Data Book (Rakonczay 1990).

This butterfly requires well-structured habitats. Larvae feed in humid deciduous forests on *Corydalis cava* and *C. solida* while imagoes prefer clearings or clear-cut spots for mating and feeding. Consequently, populations can only survive in areas where forests with host plants and clearings are both present.

Since the last glacial period the investigated area (Fig. 1) had been continuously covered with forest until the appearance of the Neolithic culture, approximately 6000 years ago (WILLIS *et al.* 1997). As a consequence of human land-use changes, large-scale deforestation started in the valleys and lowlands, resulting in the separation of the forested area of the Aggtelek-karst Mts, the Bükk

Mts, and the hardwood gallery forests of the River Tisza. The forests of the Bükk Mts have been further fragmented by clear-fellings which became extensive approximately 200 years ago. At the same time, an extreme reduction of gallery forests took place due to the regulation of the River Tisza and its tributaries and resulted in the complete isolation of the Sajólád forest.

Our aim was to study the population structure and genetic variability of *P. mnemosyne* by means of mark-release-recapture studies and enzyme electrophoresis.

In a preliminary study eleven samples were collected from the area, and analysed by means of enzyme electrophoresis (Fig. 1). The results showed that the samples were clearly separated from each other and thus originated from different populations. Genetic drift had a strong effect on the genetic structure of these populations (MEGLÉCZ *et al.* 1997).

Considering these findings there were two ways to continue our study (i) the effect of genetic drift depends on the effective size of populations. The size of the populations varied greatly in the area: three populations – Nagyoldal, Bányahegy and Lusta valley – were far larger than the others. Therefore it was interesting to investigate the effect of population size on the genetic stability of the populations. (ii) Although the samples were collected in well-defined localities in each area (situated a few km apart) we noticed that these sampling sites were rather patchy. Hence, we were interested to examine whether the structured nature of the habitat resulted in genetic differentiation between closely situated habitat patches.

MATERIALS AND METHODS

Mark-release-recapture studies

Mark-release-recapture (MRR) studies were carried out at two sites, to investigate the dispersion between habitat patches, and to estimate population sizes.

The first site, the Sajólád forest (Fig. 1, Saj) is a hardwood gallery forest along the River Sajó near the Tisza valley in the Great Hungarian Plain. The *P. mnemosyne* population is small and completely isolated here. Most of the imagoes were flying on a small clearing (approx. 150 × 400 m) while some individuals appeared in a narrow 15–20 m wide glade about 500 m far from the clearing. The two clearings were separated by a dense, mixed hardwood gallery forest.

The second site, Bányahegy (Fig. 1, Bán), with a very dense population is situated on the plateau of the Bükk Mts (approx. 800 m a.s.l.) in the beech vegetation belt. The habitat at Bányahegy was rather different from the one at Sajólád. There were several small clear-cuts, the largest ones were slightly larger than 100 × 100 m. They were often connected to each other and the vegetation separating them was either a young shrub-like beech stand or old, sparse beech forest. Three of these clearings were chosen for the MRR study with 200 m average distance between them.

Electrophoretic studies

Sample collection. In the preliminary study, eleven *P. mnemosyne* samples were collected in three regions of the NE part of Hungary (Fig. 1). Two of them were collected in the Aggtelek-karst Mts, eight from the Bükk Mts and one from Sajólád. In 1995, we repeated the sampling at the same sites (Fig. 1) except for three localities: Odorvár (Odo) Vöröskő (Vör) and Hór valley (Hór) where the butterfly abundances were too small.

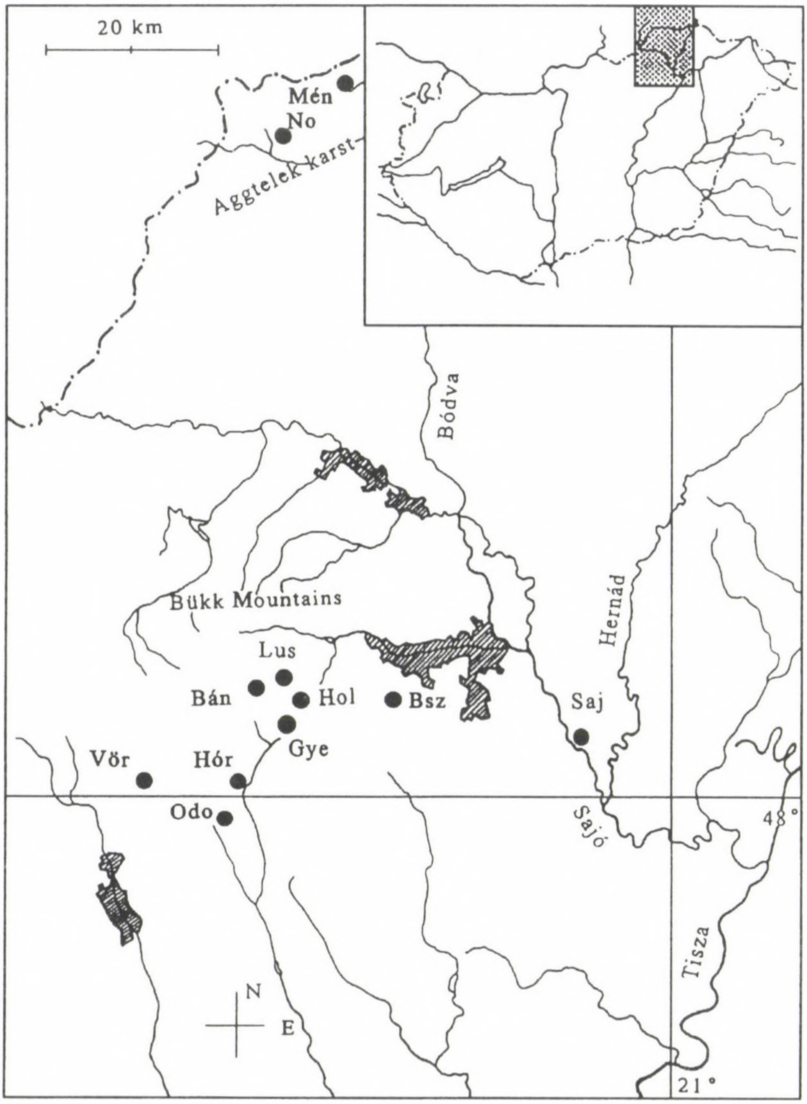


Fig. 1. Sampling localities of *Parnassius mnemosyne* populations in NE Hungary – Mts Aggtelek-karst: Nagyoldal (No), Ménes valley (Mén); Bükk Mts: Lusta valley (Lus), Bányahegy (Bán), Vöröskő (Vör), Odorvár (Odo), Hór valley (Hór), Gyertyán valley (Gye), Hollóstető (Hol), Bükkszentlászló (Bsz) and Sajólád (Saj)

In order to investigate the genetic differentiation within populations, three separate samples were collected at Bányahegy in 1995, from those clearings, where the MRR study was carried out. Although it would have been interesting to analyse genetic differentiation between the two clearings at Sajólád, we could not collect a suitable sample in the glade. In 1995, however, two samples were collected in the Nagyoldal (Fig. 1, No), approximately 600 m far from each other. These two sites were separated by a valley completely covered with dense and closed hornbean-oak forest. The density of the forest between these two sites was rather similar to that at Sajólád.

Enzyme assay. Eight loci were examined in all samples: glutamate-oxalacetate transaminase (*Got*), α-glycerophosphate dehydrogenase (*α-Gpdh*), hexokinase (*Hk*), isocitrate dehydrogenase (*Idh*), malate dehydrogenase (*Mdh*), phosphoglucose isomerase (*Pgi*), phosphoglucomutase (*Pgm*), superoxide dismutase (*Sod*). Electrophoreses were carried out on horizontal starch gel slabs using different buffer systems. Several individuals were run at least twice to check the repeatability of the banding patterns. For details see MEGLÉCZ *et al.* (1997).

Statistical analyses

MRR data. The Jolly-Seber method (SEBER 1982, KREBS 1989) was used to estimate the average number of individuals present in the populations at a given time interval. The total number of individuals during the whole flight period was also estimated by summing the estimated number of new animals recruited during each recapture interval. In order to characterise the rate of dispersion between habitat patches, we compared the number of individuals captured in at least two openings to the total number recaptured.

Enzyme electrophoresis data. Genotype and allele frequencies were calculated on the basis of the banding patterns. Exact test for population differentiation (RAYMOND and ROUSSET 1995*a*) was carried out to test the independence of the allelic compositions of the various populations. The genetic differentiation of populations was also analysed by F-statistics (WEIR & COCKERHAM 1984), the total genetic variability (F_{IT}) was partitioned into within (F_{IS}) and between (F_{ST}) population variation. Hence, F_{ST} indicates the amount of genetic differentiation between the samples compared to the total genetic variance. Zero value means that there is no variation between the samples while 1 indicates total differentiation.

Hierarchical F-statistics (WRIGHT 1978) was used to analyse the level of differentiation among samples collected in different populations in the same year, and from the same population in different years. By this method the total genetic variance among the samples was partitioned into a between population component and a between year component.

Computations were carried out with help of the following software: GENEPOP (version 1.0) (RAYMOND and ROUSSET 1995*b*) to perform exact test for population, FSTAT (version 1.2, GOUDET 1995) to compute F-statistics, BIOSYS-1 (release 1.7, SWOFFORD and SELANDER 1981) to calculate hierarchical F-statistics and genetic distances.

RESULTS AND DISCUSSION

Differentiation between habitat patches

In the MRR study, we compared the relative number of the dispersing individuals among the habitat patches in the populations at Sajólád and Bányahegy. At Sajólád, 8 animals out of 93 recaptured moved between the glade and the clearing in spite of the short distance between the two places. Dispersion, however, was more frequent between the clearings at Bányahegy. Out of 98 recaptured butterflies 13 moved between the different clearings and two of them moved twice.

Table 1. Subpopulation differentation at two sites. k = number of subpopulations, P = exact probability for population differentation * signifificant at 0.05 level

	Bányahegy	Nagyoldal
k	3	2
P	0.555	0.108
F_{ST}	0.000	0.026*

Genetic differentiation within the populations was analysed by comparing the results of the electrophoretic studies in the samples collected from the three clearings at Bányahegy and in two samples originating from Nagyoldal. Exact probabilities for population differentiation and F_{ST} values were calculated for the samples in both populations (Table 1). None of the analyses showed differentiation at Bányahegy, while the F_{ST} value was small but significantly higher than zero at Nagyoldal. It implied that the butterflies from the three small clearings belonged to the same population at Bányahegy, while there was a slight differentiation between the two samples at Nagyoldal.

The results of the MRR and electrophoretic studies are in good agreement: at Bányahegy, in spite of the structured habitat the genetic composition of the population seems to be homogeneous. This finding can be explained by the flying behaviour of the butterflies. Males search for females from morning to the early afternoon hours in sunshine. Their "random walk" covers several hundred meters. Shrub-like vegetation and sparse forest do not form an effective barrier for dispersing. Thus, gene flow can equalise the local differentiation between subpopulations.

Dense forests, however, serve as effective barrier even in short distance (e.g. at Sajólád and Nagyoldal).

Effect of population size. In the MRR study, we estimated the population size at two sites: Bányahegy and Sajólád. As we did not find genetic differentiation between the samples collected in different habitat patches at Bányahegy we estimated the population size for the three clearings together. It is remarkable that the population size at Bányahegy was about ten times larger than at Sajólád (Table 2). It appears that the assumption concerning the size of the investigated

Table 2. Results of the mark-release-recapture (MRR) study. N = average number of individuals present in the population at a given time. N_T = total number of individuals in the population during the whole flight period

	N	SE(N)	95% conf. interval	N_T
Bányahegy	471	61.5	350–592	1452
Sajólád	48	3.3	42–55	145

Table 3. Results of hierarchical F-statistics for large (Bányahegy, Lusta valley, Nagyoldal) and small (Hollóstető, Gyertyán valley, Bükkszentlászló, Ménes valley, Sajólád) populations separately

Comparison		Large populations		Small populations	
X	Y	Variance component	F_{XY}	Variance component	F_{XY}
Year-	Population	0.01067	0.008	0.03517	0.022
Year-	Total	0.08354	0.063	0.05632	0.038
Population-	Total	0.07288	0.055	0.02115	0.014

populations proved to be true, namely, three of the populations – Bányahegy, Nagyoldal and Lusta valley – were much larger than the others.

Therefore we analysed the variation between the samples collected in different years from the same population with the help of hierarchical F-statistics for the large and the small populations separately (Table 3). In the large populations, a small portion of the total variation was only found between the two years while in the small populations about 62% of the total variance was due to the between year variation and only 38% to the between-population variation. Thus, we concluded that population size had a significant effect on the genetic stability of these populations.

Keeping in mind that in the preliminary studies genetic drift proved to be the main evolutionary force acting in the populations and at the same time considering that the genetic stability of the populations depended on their size it was interesting to see the relative significance of different evolutionary forces affecting these populations with various sizes. Hence, we calculated exact probabilities for population differentiation and F_{ST} values for three different data sets. In the first data set, we included all the samples from the three large populations which were situated in two regions Fig. 1: Aggtelek-karst – Nagyoldal (No; 1994, 1995). Bükk Mts – Bányahegy (Bán; 1994, 1995) and Lusta valley (Lus; 1994, 1995). In the second data set, the samples from the large populations of the Bükk Mts were only included. In the third data set, we included all the samples from the small populations of the Bükk mountains.

When we analysed the first data set, we found clear differentiation at all loci among the samples of the large populations from the two different regions (Table 4). In contrast we observed low level of differentiation compared with the samples from the large Bükk populations (i.e. using the second data set). As the samples from the large Bükk populations were hardly differentiated, the significant inhomogeneity in the first data set could only come from the difference between the two regions. This finding was also supported by the results of hierarchical F-statistics among large populations, the between region component (F_{RT}=0.072) of the total variance among samples (F_{PT}=0.086) was much larger

Table 4. Result of the exact test for population differentiation, and F-statistics for different data sets. Data set 1: Bányahegy 1994, 1995; Lusta valley 1994, 1995; Nagyoldal 1994, 1995. Data set 2: Bányahegy 1994, 1995; Lusta valley 1994, 1995. Data set 3: Bükkszentlászló 1994, 1995; Hollóstető 1994, 1995; Gyertyán valley 1994, 1995; Hór valley 1994; Odorvár 1994; Vöröskő 1994; *** significant at 0.001 level, ** significant at 0.01 level, * significant at 0.05 level

Data sets	1	2	3
	Exact probabilities for population differentiation		
Hk	0.000***	0.225	0.000***
Pgm 0.000 ***	0.156	0.002**	
Pgi	0.000***	0.052	0.432
Total	0.000***	0.050*	0.006**
	F_{ST} values		
Hk	0.120**	0.000	0.065**
Pgm	0.080**	0.002	0.015*
Pgi	0.062**	0.023*	0.000
Total	0.002**	0.023	0.026**

than the within region component (F_{PR}=0.015). This indicates a certain geographic pattern in the genetic structure of the large populations due to restricted gene flow between the two regions.

At the same time we found strong differentiation between the samples even within a single region when we compared the small populations of the Bükk Mts (third data set). It thus appears that in the small populations genetic drift is the most important evolutionary force. Although the forested area of the Bükk became fragmented only recently in the geological sense, there was enough time for these small populations to be differentiated due to genetic drift.

* * *

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DIPTEROUS ASSEMBLAGES OF SHEEP-RUN DROPPINGS: NUMBER OF SPECIES OBSERVED, ESTIMATED AND GENERATED BY SIMULATION

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Four non-parametric methods are used to estimate species richness in samples from dipterous assemblages on sheep-run droppings in Hungary. Furthermore, Hodkinsons' method has been modified to be applicable to species richness extrapolations in any community in which the capture probability of a given taxonomic group is significantly higher than that of the rest of the species. The expected species–individual diversity ("rarefaction") method has also been applied in a comparison of field data (species numbers observed) with estimates based on different frequency structures. Simulations by urn models, related to the truncated lognormal distribution, are proposed as an originally new method to generate species numbers from field data and its perspectives are evaluated by comparing the observed and the expected species–individual diversity estimates.

Key words: species richness, non-parametric estimations, expected species–individual diversity, simulations, Diptera, sheep-runs, Hungary

INTRODUCTION

Droppings on dry sheep-runs in two Transdanubian sites (W Hungary) and one site in the Kiskunság National Park (C Hungary) were surveyed in order to detect features of community colonisation of coleopteran and dipteran populations (PAPP 1995). We collected data for each step of community organisation of these pioneer assemblages and attempted to identify the source of specimens colonising droppings. In this paper field results will be elaborated. The numbers of species detected in the field samples of flies are analysed in comparison with some known methods of estimation of species richness and a new simulation method.

Estimation of species richness is an interesting and permanently evolving field of quantitative ecology. The presence of the individuals or populations of large-bodied, highly abundant or exceedingly active species is comparatively easy to ascertain. If the individuals of a species are small-bodied, or if it is difficult to sample them for any other reason, the presence of rare species is difficult

to demonstrate. Among insects, where the rare and poorly detectable species can form a major part of species richness, this practical difficulty becomes a theoretical problem or even a problem of epistemiology. For a skilled entomologist it is obvious that the number of insect species populations present at a given point of time in an area selected for any practical reason cannot be precisely determined. We must rely on estimations obtained by some kind of approximation (in our case, extrapolations). Consequently, a large proportion of rare species always remain undetected. If rare species become extinct in a given area at an indeterminate but nevertheless exciting rate, *and* they recolonize again, we attempt to *approximate (extrapolate) the quasi-equilibrium species number*. Ecology has been confronted with these problems for a long time (for a bibliography, see e.g. SOUTHWOOD 1978). The species number estimation methods were mainly elaborated during the 1970s and 1980s, resulting in a plethora of current techniques. The development of the numerous procedures raises a question: are the dubious species numbers applicable for theoretical considerations, or, are the theories applicable and valuable if they are based on such unstable data (among others we would recommend for a review ROSENZWEIG's (1995) excellent book full of wit and fair criticism).

This paper is not an overview of the procedures and methods available for estimating species number, instead we recommend the recent and good review of COLWELL and CODDINGTON (1994) on extrapolation methods. Only a limited number of procedures known in the vast literature is selected for analysis of our data and for comparison with the results obtained by the new method proposed.

We would like to stress that two approaches are presented in this paper for the number of species: a) we had several but individually inadequate samples for the estimation of the total number of species in the site; b) we set out from a definite frequency structure to estimate the undetected number of species at an actual time and place.

The paper consists of the following parts:

Four non-parametric methods are used to estimate species richness from the samples.

Hodkinsons' method, originally developed for estimating the total number of species in unexplored faunas (or, unknown, undescribed species), is modified. It is adopted to situations when there are subgroups with significantly different capture probabilities. In such cases we may apply an estimation for the *probable – closer to actual – total number of species* by assuming the total number of species if all were caught by the probability of the best collectible subgroup. According to COLWELL & CODDINGTON's (1994) classification, this is a "taxon ratio" method of estimation and extrapolation .

Applying the expected species–individual diversity ("rarefaction") method, our field data on the observed number of species were compared to the *ES(m)*

values generated by calculations from *supposed "communities" of different relative abundance vectors*. The parameter m equals sample size in all cases. In this case we actually do not aim at estimation number of species. The comparison of the estimated and observed species numbers was used to evaluate whether the relative abundance vector/plot of a given sample and that of the "community" are congruent with the known relative abundance vector, we chosen as basis.

Finally we propose a new simulation method based on urn models related to the truncated lognormal distribution. To test the new method, the estimations of the species numbers generated by simulation are compared to the observed numbers.

MATERIALS AND METHODS

The data matrix (on Diptera sampled from 20 pieces of sheep droppings for a sample in each of three Hungarian dry sheep-runs by isolators, 1991–94) was published in a former paper (PAPP 1995: Table 1) and is not repeated here. For coding the samples, two or three letters for the site and two numerals for the year, month and day were used (FP: Zámoly: Forráspuszta, VB: Vértesboglár, KSZ: Kunszentmiklós. For example, KSZ940615 is for the Kunszentmiklós site on the June 15th, 1994).

Based on our experience we can say that there are no differences in the species composition in late spring, early summer and early autumn, as far as the important dipterous species are concerned (PAPP 1985). This is why we can regard all the samples collected at the same place and year as samples from the same pool populations. We are aware of the limits of this assumption, but we think this is admissible here, since this paper is primarily methodological.

Four non-parametric methods (CHAO 1984, PALMER 1990, 1991) of those given in COLWELL & CODDINGTON (1994) are applied. The estimations are based on the following equations (symbols as in COLWELL & CODDINGTON 1994, so S_o is the number of species observed; n denotes the sample size):

$$\text{"Chao 1"}: S_{e1} = S_o + a^2/2b$$
$$\text{"Chao 2"}: S_{e2} = S_o + L^2/2M$$
$$\text{"Jackknife 1"}: S_{e3} = S_o + L(n-1)/n$$
$$\text{"Jackknife 2"}: S_{e4} = S_o + [L(2n-3)/n - M(n-2)^2/n(n-1)]$$

Singletons (a) and doubletons (b), single occurrences (L) and double occurrences (M) of species in the original samples were determined (Table 1). Clearly, the Chao 1 estimate relates to a single sample, the other estimates relate to a group of samples.

Species-accumulation plots are well-known and frequently used (BALOGH 1953, ENGEN 1978). For a spatially completely random community, the *expected number of species* is defined as follows:

$$ES(m) = S - \sum_{i=1}^{s}(1 - p_i)^m$$

where s stands for the number of species, p_i (i = 1,..., s) denotes the probability of the ith species in the community and m is the number of individuals in a sub-sample (HURLBERT (1971); this measure is often referred as *Hurbert index* (IZSÁK 1994, 1996). *ES(m)* is also mentioned as *rarefaction diversity* (or even, mistakenly, rarefraction). *ES(m)* along with other, recently developed methods, also can be used for scale-dependent characterization (TÓTHMÉRÉSZ 1995).

Each original sample (i.e. 32 samples except for those with very low total abundance) was tested by the proper option of the DIVERSI software (IZSÁK 1997) to fit to the truncated lognormal and to the log-series distributions. This software contains – among others – routines to calculate jackknife estimates with confidence intervals and significance tests of differences for several diversity indices. Moreover, it offers fitting procedures for the most popular species abundance distributions. The truncated lognormal model provides an S^* estimate of the total species number.

Simulations based on urn models related to the truncated lognormal distribution were made (for details see PAPP & IZSÁK 1997). Two 100-species models, Model 305262/100 and Model 480362/100 were modified in each case to the total abundance equal to that of the field sample. In each case 100 simulated records (species abundance series) were generated and the simulated number of species was recorded. First of all samples with leading relative frequencies similar to that of the model are examined.

Table 1. Singletons (*a*) and doubletons (*b*) in the samples, single occurrences (*L*) and double occurrences (*M*) of species in the sample groups (cf. PAPP 1995: Table 1). Symbols as given in COLWELL & CODDINGTON (1994)

	a	b	L	M
FP920603	7	7		
FP920603	10	3		
FP920916	11	3	30	16
FP921006	8	4		
VB920513	15	4		
VB920526	12	8		
VB920528	13	4		
VB930525	8	3	23	15
VB930609	9	5		
VB930630	7	5		
VB930914	7	2		
KSZ910926	8	2		
KSZ920519	11	6		
KSZ920601	11	4		
KSZ920616	11	3	23	8
KSZ920923	4	2		
KSZ921013	5	3		
KSZ930519	9	5		
KSZ930602	9	6		
KSZ930615	12	2		
KSZ930622	7	3		
KSZ930910	5	1	28	11
KSZ930916	9	2		
KSZ930928	8	2		

Table 1 (continued)

KSZ931013	9	3		
KSZ940519	12	4		
KSZ940602	9	7		
KSZ940608	7	8		
KSZ940614	9	1	32	14
KSZ940615	10	3		
KSZ940621	10	4		
KSZ940628	13	2		
KSZ20	24	17	31	15
KSZ21	26	15	34	13

RESULTS AND DISCUSSION

Non-parametric methods of extrapolation

The estimated number of species calculated by the four methods are summarised in Table 2. The *combined* sample of the summarised abundances in all the 21 samples from Kunszentmiklós is coded as "KSZ21"; neglecting one of the 21 samples due to extremely high total abundance and with superdominance of *Coproica vagans*, we receive the combined sample coded "KSZ20". As we can judge here and as PALMER (1990) noted, the first-order jackknife estimator may give the most conservative estimates, being the nearest to the observed species richness (that is, a conservative estimation is proposed as best). The 96 dipterous species which were collected in the field of the "puszta" at Kunszentmiklós must be characteristic of the fly community there to a given extent/measure. There is no other *absolute* means for the assessment of the estimators but the total number of species observed. This is why we must regard the most conservative estimation as the best one.

As seen in Table 2, the second-order jackknife estimator gives higher values than the first-order jackknife. With a single exception, the "Chao 2" estimator gives higher values than the first-order jackknife.

The modified Hodkinsons' method (cf. HODKINSON & HODKINSON 1993)

Species of the dipterous family Sphaeroceridae were collected on sheep-run droppings with higher probability than the other flies. So, we selected sphaerocerids as the reference-group and applied Hodkinsons' method *mutatis mutandis* in calculating (estimating) the number of species by assuming that all the dipterous species are caught by the same probability as the sphaerocerids.

Table 2. Species numbers estimated in samples by non-parametric methods of extrapolation (the observed numbers for samples, sites or for site-and-year in brackets)

		Chao 1	Chao 2	Jackknife 1	Jackknife 2
FP920603	(34)	37.5			
FP920603	(23)	39.67	83.13	77.5	87.17
FP920916	(20)	40.17		(55)	
FP921006	(17)	25.0			
VB920513	(27)	55.1			
VB920526	(27)	36.0			
VB920528	(28)	49.13			
VB930525	(15)	25.67	77.63	79.71	87.21
VB930609	(18)	26.1		(60)	
VB930630	(20)	24.9			
VB930914	(15)	27.25			
KSZ910926	(12)	28.0			
KSZ920519	(24)	34.08			
KSZ920601	(22)	37.13	79.06	65.17	76.23
KSZ920616	(19)	39.17		(46)	
KSZ920923	(6)	10.0			
KSZ921013	(12)	16.17			
KSZ930519	(25)	33.1			
KSZ930602	(24)	37.5			
KSZ930615	(24)	60.0			
KSZ930622	(19)	27.17	96.64	85.5	99.43
KSZ930910	(11)	23.5		(61)	
KSZ930916	(15)	35.25			
KSZ930928	(20)	36.0			
KSZ931013	(20)	33.5			
KSZ940519	(36)	54.0			
KSZ940602	(23)	28.79			
KSZ940608	(24)	27.06			
KSZ940614	(18)	58.5	105.57	96.43	110.95
KSZ940615	(21)	37.67		(69)	
KSZ940621	(23)	35.5			
KSZ940628	(23)	65.25			
KSZ20	(93)	109.9	125.03	122.45	137.56
KSZ21	(96)	118.5	184.92	128.38	147.97

First, calculations were made to compare data from Forráspuszta and Vértesboglár (under FP: number of species observed only at Forráspuszta; under VB: number of species observed only at Vértesboglár; FP&VB: number of species observed at both localities; p: value of capture probability estimate produced from the observed data). In the second set, calculations used the data obtained at the same place, Kunszentmiklós, but in two consecutive years, in 1993 and 1994.

The chi-square statistic was calculated in order to show that the sites (or years) were not different as to the number of species in each category but sphaerocerids *and* other flies had different capture probabilities.

	FP	VB	FP & VB	Σ
sphaerocerids	5	7	12	24
other flies	20	23	18	61

$p_{sph} = 0.50$, $p_{o.f.} = 0.295$, $p_{sph} / p_{o.f.} = 1.694$

chi-square calculations:

species	FP	VB	Σ
sphaerocerids	17	19	36
other flies	38	41	79
	55	60	115

chi-square = 71875/9385200 = 0.007658, $0.90 < p < 0.95$

species	FP or VB	FP & VB	Σ
sphaerocerids	12	12	24
other flies	43	18	61
	55	30	85

chi-square = 7650000/2415600 = 3.17, $0.10 > p > 0.05$

	KSZ93	KSZ94	KSZ93 & 94	Σ
sphaerocerids	3	9	22	34
other flies	15	16	22	53

$p_{sph}= 0.647$, $p_{o.f.} = 0.415$ $p_{sph} / p_{o.f.} = 1.559$

chi-square calculations

species	KSZ93	KSZ94	Σ
sphaerocerids	25	31	56
other flies	37	38	75
	62	69	131

chi-square = 5083979/17967600 = 0.2830, $0.50 < p < 0.70$

species	KSZ93 or 94	KSZ93&94	Σ
sphaerocerids	12	22	34
other flies	31	22	53
	43	44	87

chi-square = 15200988/3409384 = 4.46, $0.05 > p > 0.02$

If all the flies were captured with the same probability as the sphaerocerid species, 1.694*38 + 17 = 81 species at Forráspuszta and 1.694*41 + 19 = 88 species at Vértesboglár would be collected (instead of 55 and 60 species observed). Again, under the same assumption 1.559*37 + 25 = 82 species and 1.559*38 + 31 = 90 species would have been collected in Kunszentmiklós in 1993 and in 1994 (instead of 62 and 69 species observed), respectively.

Hodkinsons' method modified this way is applicable to extrapolations in communities where the capture probability of a given taxonomic group is significantly higher than that of the rest of the species.

The expected species–individual diversity estimates for indirect evidence of community dominance structure

The expected species–individual diversity ("rarefaction") method was applied to estimate species richness at Kunszentmiklós, using the frequencies in the combined samples of "KSZ20" and "KSZ21", and of the Model 305262/100 truncated lognormal distribution urn model as the "supposed community", respectively. The results are summarised in Table 3.

A significant difference between the ES(m) values and those of the observed numbers *in a well-known, stable community* would reveal that sampling was non-random. This possibility is certainly excluded in our study. We propose below an "inverse" way of thinking for the application of the expected species–individual diversity method in order to obtain information on *the community frequency structure* of poorly known field communities by ES(m) estimations from different *test communities*. Here *m* equals the sample size.

Looking at the data in Table 3, one can come to the conclusion that in the range of abundances between 339 to 343, estimations based on the community KSZ20 and KSZ21 are equally distant from those of the M305262 community (KSZ20 estimates are higher, those of KSZ21 are lower). When numbers are higher, estimates of KSZ21 are closer to those of M305262; when lower with numbers KSZ20 estimates are closer to those of M305262.

If the sample size *n* is small, ES(m) underestimates the species numbers based on all the three communities, though with community KSZ20 and M305262 the underestimated values are not far from observed values. Since KSZ930602 is an extreme sample (see PAPP 1995), it was better to leave it out

Table 3. The expected species-individual diversity and its evaluation (n: number of individuals, S_o: number of observed species, S_e: estimated number of species, O: overestimated, U: underestimated, *: good estimates: difference 10 % of max(S_o, S_e) in the samples from Kunszentmiklós

	n	S_o	Supposed community					
			KSZ20	S_e	KSZ21	S_e	M305262/100	S_e
KSZ910926	20	12	8	U	6	U	9	U
KSZ920519	78	24	16	U	12	U	16	U
KSZ920601	175	22	23	*	17	U	22	*
KSZ920616	68	19	15	U	11	U	15	U
KSZ920923	8	6	5	*	4	U	5	*
KSZ921013	48	12	12	*	9	U	13	*
KSZ930519	543	25	40	O	30	O	31	O
KSZ930602	4733	24	–		–		53	O
KSZ930615	183	24	24	*	18	U	22	*
KSZ930622	212	19	26	O	19	*	23	O
KSZ930910	41	11	12	*	9	U	12	*
KSZ930916	37	15	11	U	8	U	12	U
KSZ930928	472	20	37	O	28	O	30	O
KSZ931013	980	20	52	O	40	O	37	O
KSZ940519	751	36	46	O	35	*	34	*
KSZ940602	107	23	19	U	14	U	18	U
KSZ940608	226	24	26	*	20	U	24	U
KSZ940614	135	18	21	O	15	U	20	*
KSZ940615	339	21	32	O	24	O	27	O
KSZ940621	182	23	24	*	18	U	22	*
KSZ940628	343	23	32	O	24	*	27	O

when considering the "community", i.e. the total number of specimens was used as a basis.

A characteristic trait of the frequency structure is the ratio of the leading frequencies: those of KSZ20, KSZ21 and M305262 are 1369/4948= 0.277, 5828/9681= 0.602 and 0.305, respectively. It appears that the results with this method are sensitive to the extremely high frequencies of the sample studied (in these cases it overestimates the species number). It must be noted that comparatively the best estimates are given by the M305262 model and *not the frequency structure we really obtained from the total abundances at Kunszentmiklós*.

The free use of *supposed "communities" of different relative abundance vectors* as basis for estimations gives us a wide range of possibilities, when comparing the frequency structure of field samples to that "community" structure.

Table 4. Results of simulations with Model 305262/100: mean, minimum and maximum of species numbers in 100 simulated records (S_O: species number observed, S^* estimate from the fit tests; IZSÁK's DIVERSI software)

	n	S_O	S^*	species numbers from simulations		
				mean	min.	max.
FP920603	348	34	39.8	27.23	22	32
FP920603	208	23	46.6	23.69	17	29
FP921006	45	17	19.0	12.83	8	19
VB920528	289	28	71.5	25.65	20	31
VB920513	114	27	47.7	19.12	13	27
VB920526	130	27	41.2	19.96	16	26
VB930525	130	15	218.7	19.96	16	26
VB930630	88	20	22.7	16.95	12	21
VB930914	47	15	17.2	13.09	8	19
KSZ920519	78	24	28.8	16.06	10	21
KSZ920601	175	22	61.1	22.25	16	29
KSZ920615	183	24	44.3	22.71	18	30
KSZ930622	212	19	32.1	23.25	18	29
KSZ930916	37	15	18.6	11.73	8	17
KSZ940621	182	23	43.3	21.87	16	27

The ES(m) values generated in a process of approximation may serve as *indirect evidence of the community frequency structure*.

Number of species derived from the truncated lognormal distribution

A good fit to the truncated lognormal distribution, in contrast to the log-series and geometric series distributions, was found in the field samples, except for VB930630 and VB930914, where a better fit was found to the log-series distribution (chi-square values are not given here). Simulation results (mean, minimum and maximum of species numbers in 100 simulation records), S_o (number observed) and S^* (theoretical number of species yielded by the fitting procedure) are given in Tables 4 and 5.

For the assessment of the simulation results, the graphs of relative frequency distribution in the KSZ21 and KSZ20 combined field samples (with 96 and 93 species) and of the urn models relating to the truncated lognormal distribution were compared.

When comparing the two combined field samples, it is surprising that if we drop the sample which gave half of the total abundance, this procedure reduces the total species number by three, but *the community frequency structure* is little

Table 5. Results of simulations with Model 480362/100: mean, minimum and maximum of species numbers in 100 simulated records (S_O: species number observed, S^* estimate from the fit tests; IZSÁK's DIVERSI software)

	n	S_O	S^*	species numbers from simulations		
				mean	min.	max.
KSZ920601	175	22	61.1	20.94	16	28
KSZ930519	543	25	72.7	33.17	25	41
KSZ930615	183	24	44.3	21.67	14	27
KSZ930622	212	19	32.1	22.92	17	32
KSZ930928	472	20	122.6	31.44	25	37
KSZ940519	751	36	54.6	37.51	29	46
KSZ940615	339	21	210.7	27.73	21	34
KSZ940628	343	23	n.c.	27.55	21	34

affected (Fig. 1). When any of the two combined field samples and simulation model M305262/100 are plotted on the same scale (see Fig. 2) it is obvious that the α-section of the former is less steep (i.e. the left (upper) half of that graph is underposed to that of the truncated lognormal model). This satisfactorily explans

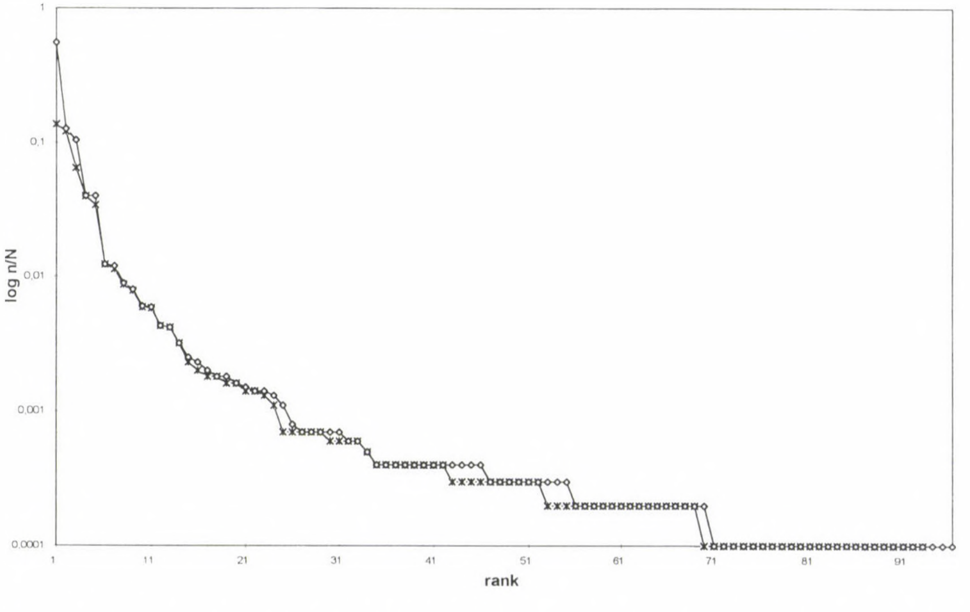


Fig. 1. Relative frequency distribution in the KSZ21 and KSZ20 combined samples (with 96 and 93 species): "KSZ21" (open diamonds) and "KSZ20" (asterisks) on logarithmic scale

why we had lower observed species numbers in several cases than the corresponding simulation results. Some other correlations based on our experience and on elementary considerations are as follows:

For models identical or very similar in their *other* main characteristics, such as the total abundance, number of species, steepness of the α-section, relative frequency of the centrally/medially ranked species (below: "median"), leading frequency, *the number of species generated by simulation is higher* if

a) the α-section is steeper (Fig. 3; compare the corresponding values in Table 4 and Table 5).

b) the leading frequency is lower (cf. RTS or Right-Tail-Sum diversity in TÓTHMÉRÉSZ 1995);

c) the median is lower in the case of the model.

We think that the proposed computer simulation method is useful for species number estimation as well as for analysis of community frequency structure. Tests by urn models with parameters such as leading frequency, median, steepness of α-section, etc., similar to those of the field communities seem very promising. We are still only exploring this kind of simulation and analyse their potentials, so only a limited number of remarks is made here.

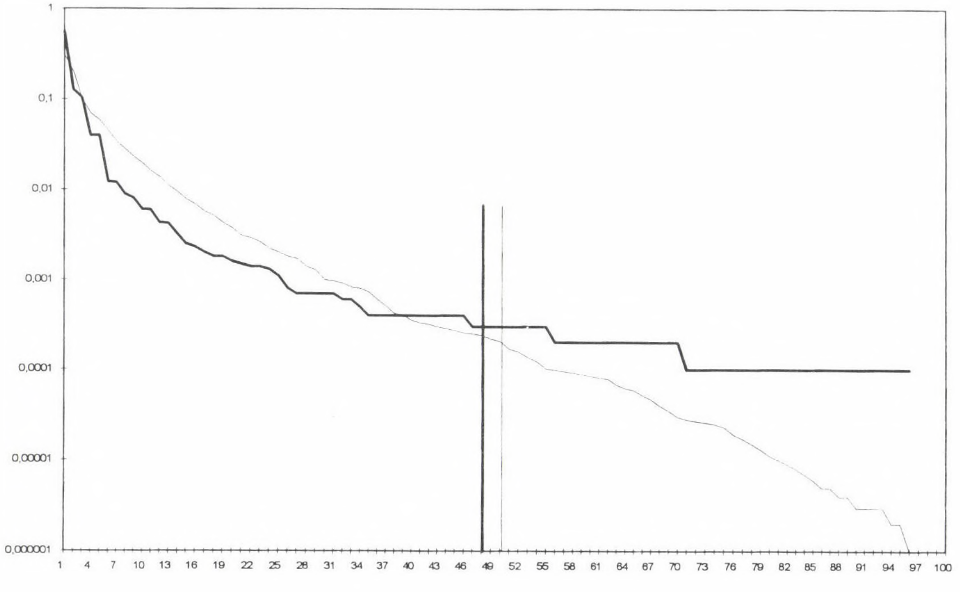


Fig. 2. Relative frequency distribution in the "KSZ21" combined sample of 96 species (thick line) and in the truncated lognormal model M305 262/100 (thin line) on logarithmic scale (horizontal lines show their medians)

When a series of samples is taken for the same sites, collecting more and more animal individuals, the imaginary relative abundance graph is formed from the direction of the high ranks and the emergence and frequencies of the rare species are added as amplifications. This is why the rank-abundance curve made from samples of inadequately small abundances is nearly linear at the logarithmic scale, and thus reflects *the underdetection of rare species*. It is trivial to say that the relative position of two species on the graph is determined by the ratio of their abundance, but it is just as trivial that the addition of one individual to the domain of dominant-subdominant species causes change in the sequence by very low probability, contrary to that in the domain of the rare species, not to mention the differences in the shape of the graph, since it is a logarithmic one.

This simulation method seems advantageous even if compared to the potentials of ES(m) estimations. With a given frequency structure of a community, ES(m) calculation gives a single estimate, although by any method of re-sampling, e.g. jackknifing ES(m) (see IZSÁK 1994, 1996), confidence intervals can be calculated. At the same time, the proposed simulation, based on a given frequency structure, can be made in a discretional number, the numerical results of a simulation series make it possible to calculate the mean, variance, etc. As a by-

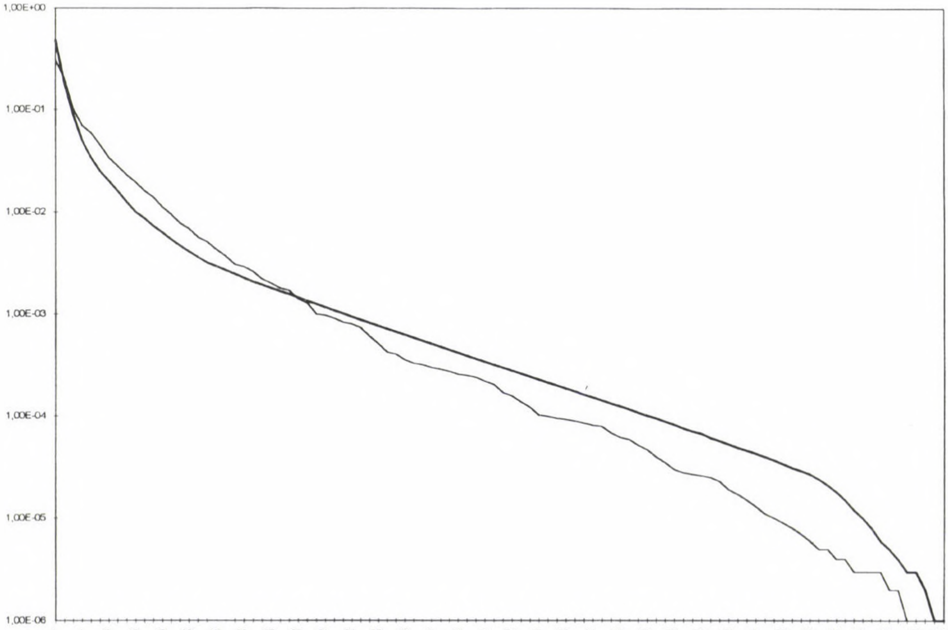


Fig. 3. Relative frequency distribution in the lognormal models (with 100 species) used in simulations: model M480 362 (thick line) and model M305 262 (thin line) on logarithmic scale

product of the procedure, one receives an additional estimate of the species number, the S^* value.

CLOSING REMARKS

The application of test communities with different species–individual diversity and simulations by urn models we described above may be used parallel for a better approach to frequency structure of poorly known field communities. In this phase we would recommend an approximation procedure to reach a congruence of the frequency structure of field communities and that of the simulation models by modifications in the model structure.

It is not surprising that owing to the difficulties in methodology mentioned in the introduction, species number estimations and their concrete procedures have been viewed by scepticism by some insect ecologists. We think that this field of ecology is no less exact than some other fields of science (e.g. the molecular biology) but the numerical results are less reproducible since the number of species at a site may change within minutes. Furthermore, there is possibly a reasonable limit to the development of a mere statistical side of the methods. However, improvement of sampling methods *and a lot more data from field sampling* are required, in order to amplify the reliable primary data on true Nature, to improve the authentity of the procedures, etc. This is why one must regard as a permanent intention/programme to recognize, test and improve species numbers in communities, when studying insect communities.

* * *

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NEW ALTICINAE AND GALERUCINAE (COLEOPTERA, CHRYSOMELIDAE) FROM SOUTH ASIA

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Four new species: *Manobia merkli* (North India, Nepal), *M. fasciata* (North India), *M. bimaculata* (North Vietnam), *Monolepta merkli* (North Vietnam) and a new subspecies, *Livolia minuta indica* (South India) are described.

Key words: new taxa, Coleoptera, Chrysomelidae, Alticinae, Galerucinae, *Manobia*, *Monolepta*, *Livolia*

Thanks to the kindness of Dr. O. MERKL, I have been able to study a chrysomelid material from South Asia deposited in the Hungarian Museum of Natural History, Budapest (HNHM), among which a few new taxa of Alticinae and Galerucinae were found. Their descriptions are given below.

The following abbreviations are used for type depositories: HNHM – Hungarian Natural History Museum, Budapest; BMNH – Naturhistorisches Museum, Basel; LM – author's collection.

Subfamily ALTICINAE

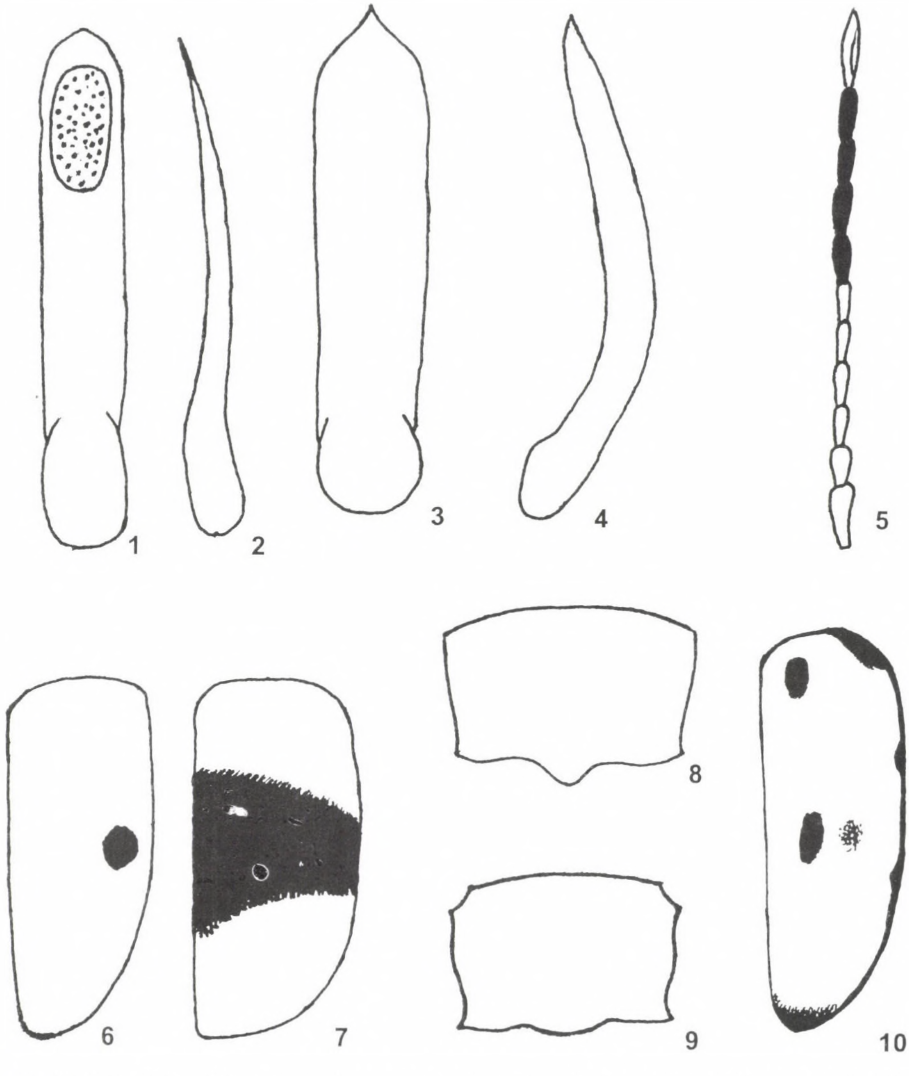
Manobia merkli sp. n.
(Figs 1–2)

Red fulvous, antennae and legs much paler, flavous; elytra usually slightly darker than prothorax.

Body elongate, widened behind. Head impunctate, clypeus about as long as broad, flattened, with narrow and sharp longitudinal ridge, not widened anteriorly; frontal tubercles small, triangular, sharply limited, frontal grooves deep. Antennae with segment 3 equal to 2, segments 4–6 only a little longer than 3, subequal; preapical segments very feebly thickened. Prothorax 1.3 times as broad as long, widened anteriorly and constricted before base, anterior margin feebly arcuate, basal margin bisinuate, with well-developed basal lobe; basal transverse groove almost straight, with a row of punctures; rest of surface impunctate. Elytra 1.25 times as long as broad, with high humeral tubercle and basal convexity; elytral rows with fine punctures except in postbasal impression, basal margin and scutellum and on sides; interspaces flat on dorsum, and convex on sides, smooth and shining. Segment 1 of fore and middle tarsi slightly widened in male. Aedeagus (Figs 1, 2) narrowly rounded on apex, without any sculpture or impressions on underside except unsclerotized window in apical part. Length of body 2.1–2.2 mm.

Holotype (male): "India, West Bengal, Darjeeling Dist., Debrapani, 1700 m, 29. V. 1980, leg. G. Topál" (HNHM).

Paratypes: same locality, 30. V. 1980, 4 spec. (HNHM, 2 spec. in LM); Darjeeling Dist., Rinkingpong, 2000 m, 22. IV. 1986, leg. C. Rai, 1 ex. (BMNH); – East Sikkim, Deehiling, 1200 m, 19. IV. 1984, leg. C. Rai, 1 ex. (BMNH); – Nepal: Num, 1550 m, 5–6. VI. 1983, leg. M. Brancucci, 1 ex. (BMNH); Mure-Arunthan, 1300 m, 9. VI. 1983, leg. M. Brancucci, 1 ex. (BMNH); Kathmandu Valley, Gufa-Gorza, 2100–2800 m, 4. VI. 1985, leg. M. Brancucci, 1 ex. (BMNH); Ilam, 1550–2600 m,7. X. 1978, leg. B. Bhakta, 9 ex. (BMNH, LM).



Figs 1–10. 1–9 = *Manobia* spp. – aedeagus, ventral and lateral: 1, 2 = *M. merkli* sp. n., 3, 4 = *M. bimaculata* sp. n.; 5 = antenna of *M. fasciata* sp. n.; 6, 7 = elytral pattern: 6 = *M. bimaculata* sp. n., 7 = *M. fasciata* sp. n.; 8, 9 = prothorax: 8 = *M. bimaculata* sp. n., 9 = *M. fasciata* sp. n.; 10 = *Monolepta merkli* sp. n., elytral pattern

The new species is similar to *M. dorsalis* JACOBY, 1896 from South India, but the elytra is unicolorous, including the suture. Morphologically it is also very near to *M. krishna* SCHERER, 1969, but the latter species is black and has a very acute apex of aedeagus (SCHERER 1969).

Manobia bimaculata sp. n.
(Figs 3, 4, 6, 8)

Entirely fulvous with black or pitchy round spot in middle of elytron, near to side margin and suture very narrowly black (Fig. 6).

Body elongate. Head impunctate except 2–3 strong punctures on each side of clypeus; latter moderately elongate and feebly longitudinally carinate. Frontal tubercles small, triangular, sharply limited; frontal furrows deep, vertex moderately convex, with setiferous pore on each side. Antennae with segment 3 shorter than 2 or 4, segment 5 a little longer than 4, further segments more or less subequal. Prothorax (Fig. 8) 1.2 times as wide as long, distinctly divergent anteriorly and feebly constricted before base, anterior margin arcuate, basal margin with strongly produced, triangular basal lobe; basal transverse groove bisinuate, with a row of moderately strong punctures, rest of surface shining, very finely and sparsely punctate. Elytra 1.4 times as long as wide, with high humeral tubercle; rows of punctures regular and strong, absent on moderately high basal convexity and almost indistinct on apical slope. Segment 1 of anterior tarsi slightly widened in male. Aedeagus (Figs 3, 4) with acute apex. Length of body 2.3–2.5 mm.

Holotype (male): Vietnam, Prov. Vinh Phu, Tam Dao, 900 m, 11. V. 1987, netting (N 138), leg. Matskási, Oláh and Topál (HNHM).

Paratypes: same locality, 2 ex. (HNHM, LM); – same locality, 2–11. VI. 1983, leg. V. Kuban, 1 ex. (BMNH).

In the HNHM material the province is indicated as Vinh Yen; in reality Tam Dao is located in the province Vinh Phu.

This species is similar to *M. bryanti* SCHERER, 1969 (= *M. dohertyi* BRYANT, 1939 nec *dohertyi* JACOBY, 1893) from Burma, but its body is larger, the elytra are with round with black spot instead of transverse band.

Manobia fasciata sp. n.
(Figs 5, 7, 9)

Red fulvous; antennal segments 7–10, broad band on elytra behind basal convexity, widened on suture (Fig. 7) and underside dark pitchy.

Body robust. Head impunctate, clypeus rather short, with narrow longitudinal ridge, widened anteriorly; frontal tubercles small, sharply limited, frontal furrows deep. Antennae (Fig. 5) with segments 3–6 almost equal, thin; further segments thickened and slightly longer. Prothorax 1.5 times as broad as long, distinctly divergent anteriorly and constricted before base, anterior margin arcuate, basal margin also arcuate, with feebly produced basal lobe (Fig. 9), basal transverse groove bisinuate and strongly punctate, rest of surface shining, sparsely and finely punctate. Elytra 1.2 times as long as broad, with prominent humeral tubercle, basal convexity not very high, rows of

punctures distinct throughout, but finer apically, interspaces smooth and shining, flat on dorsum and slightly convex on sides. Length of body 1.5–1.7 mm.

Holotype (female): India, West Bengal, Darjeeling Dist., Pesoke, 800 m, 3–4.VI.1980, netting in undergrowth, leg. G. Topál (HNHM).

Paratypes: same locality and date, 14 spec. (HNHM, 3 spec. in LM).

The new species is closely related to *M. dorsalis* JACOBY, 1896 and *M. bryanti* SCHERER, 1969, but the elytral pattern is different from both and the antennae are with intermediate segments black.

Livolia minuta indica ssp. n.

Fulvous or reddish fulvous, elytra usually paler than prothorax, but often more or less darkened around scutellum; last antennal segment and underside pitchy black.

Head shining, frontal tubercles indistinct, frontal grooves deep and sharp, forming an acute angle of about 70° and directed to hind margin of eye. Vertex without impressions, with usual 4 setiferous pores in a transverse row and a few additional ones along frontal grooves. Prothorax practically same as in nominative subspecies, lateral margins with rather feeble angulation behind anterior angles, feebly serrate, surface strongly and moderately densely punctate, but sparser that compared with the nominative subspecies. Elytral rows more or less irregular in the scutellar area. Length of body 1.3–1.4 mm.

Holotype: India, Tamil Nadu, Nilgiri, Ootacamund Dodabetta, 2500 m, 21.III.1980, leg. G. Topál (HNHM).

Paratypes: same locality, 25 spec.; – Nilgiri, Coonoor, Black Bridge Res. Forest, 2130 m, 14. III. 1980, 8 spec.; – Tamil Nadu, Palni Hills, Kodaikanal, 2300 m, 9. IV. 1980, 2 spec.; – W. Bengal, Calcutta, Ramakrishna Mission guest house, at light, 16–20. XII. 1979, 1 spec. All material was collected by G. Topál (HNHM, 4 spec. – LM, 1 spec. – BMNH).

This subspecies differs from the typical *L. minuta* (JACOBY, 1887) in its pale coloration and less densely punctured prothorax.

In recent years the genus *Livolia* has often been united with the North American genus *Orthaltica*.

Subfamily GALERUCINAE

Monolepta merkli sp. n.
(Fig. 10)

Pale flavous; labrum, antennae except 1–3 basal segments, scutellum, tibiae and tarsi black or dark piceous. Elytra narrowly margined with black (more widely on apex); humeral tubercle connected with basal margination, a spot near scutellum sometimes reduced, another one behind middle sometimes very small and indistinct patch near the latter black or piceous; lateral dark margination widened before and behind middle (Fig. 10). Pygidium slightly darkened.

Head dull, microsculptured, without punctures. Antennae with segments 2 and 3 subequal, segment 4 almost as long as two preceeding together, further segments subequal to 4. Prothorax 1.7

times as wide as long, narrowed anteriorly, with transverse impression on each side, dull and impunctate. Elytra feebly widened to behind, with sparse erect hairs on apical slope, finely and densely punctate, with microsculptured interspaces. Segment 1 of hind tarsus twice as long as next segments together. Length 3.3–3.7 mm.

Holotype (male): Vietnam, Prov. Vinh Phu, Tam Dao, 900 m, on light, 28.01.1986 (No. 22), leg. Mahunka-Oláh (HNHM).

Paratypes: same locality, 1 male, 1 female (HNHM, LM).

The new species is similar to *M. duodecimmaculata* JACOBY, 1889 and *M. wilsoni* KIMOTO, 1989, but the elytral spots are less numerous and differently placed.

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NEW AFRICAN AND ASIAN SPECIES OF LEIODINAE (COLEOPTERA: LEIODIDAE) FROM THE HUNGARIAN NATURAL HISTORY MUSEUM IN BUDAPEST

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Zeadolopus merkli sp. n. from Malaysia, *Z. ventriculus* sp. n. from Ethiopia, *Dermatohomoeus hamatus* sp. n. from Indonesia (Kalimantan Barat) and *Colenisia tanzaniae* sp. n. from Tanzania are described. *Cyrtusa freyana* HLISNIKOVSKY, 1968, *C. conicitarsis* CHAMPION, 1925 and *C. serrativentris* CHAMPION, 1925 are transferred to the genus *Zeadolopus* BROUN, 1903. *Zeadolopus* is recorded for the first time from Africa. The African species of *Zeadolopus* are keyed, and its members are listed.

Key words: taxonomy, Leiodidae, Leiodinae, *Zeadolopus*, *Dermatohomoeus*, *Colenisia*, Africa, Asia

INTRODUCTION

Currently, 42 species are recognized in *Zeadolopus* BROUN, 1903. The Asian species of have been studied by DAFFNER (1982, 1983). At present ten species are known from India and Srí Lanka, and one from Korea. An additional species from Malaysia is described below. The group was previously unknown from Africa although the allied genus *Cyrtusa* ERICHSON, 1841 is represented there by at least four species (HLISNIKOVSKY 1966, 1968). A new species of *Zeadolopus* from Ethiopia is given below. In addition to the descriptions of new species from Ethiopia and Malaysia, three species are transferred from *Cyrtusa* to *Zeadolopus*, and a checklist of the 47 species of *Zeadolopus* is presented.

The genus *Dermatohomoeus* HLISNIKOVSKY, 1963 includes 28 species distributed in Asia, Melanesia and Australia. The group has been studied by DAFFNER (1986*a*, 1988*a*, 1990) and ŠVEC (1996). An additional species from Indonesia is described here.

The 43 species belonging to *Colenisia* FAUVEL, 1903 are known to occur in Africa, Asia and the Australian region. The genus recently was studied by DAFFNER (1986*b*, 1987, 1988*b*, 1989, 1991), ANGELINI & ŠVEC (1994) and ŠVEC (1996). A new species from Tanzania is described in this paper.

The material on which this paper based is housed in the Hungarian Natural History Museum (HNHM) and the author's collection.

Zeadolopus merkli sp. n.
(Figs 1–4)

Type material – Holotype, male: Malaysia, Pahang, Cameron Highlands, Tanah Rata, edge of degraded rainforest, flight intercept trap, No. 100, 21.III. – 2.IV.1995, O. MERKL [lgt.]. Deposited in the HNHM.

Description – Reddish brown, tip of mandibles, posterior margin of pronotum, margins of scutellum and elytral suture darker, antennae reddish yellow, antennal club pale chestnut. Underside of body chestnut, legs reddish brown.

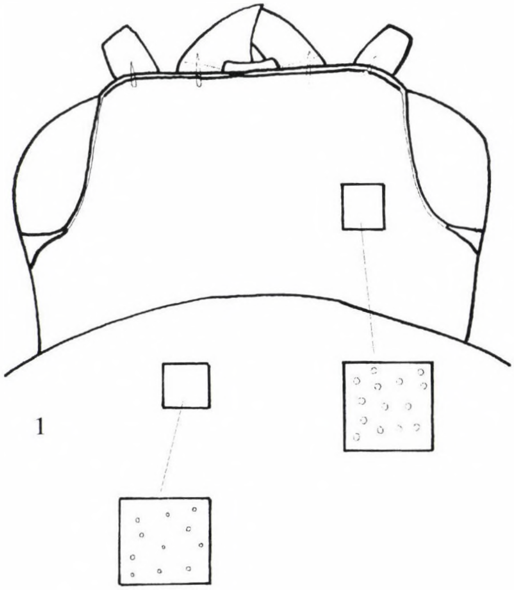
Length of body 2.2 mm, head 0.3 mm, pronotum 0.5 mm, elytra 1.4 mm, antennae 0.5 mm. Maximum width of head 0.7 mm, pronotum 1.3 mm, elytra 1.4 mm.

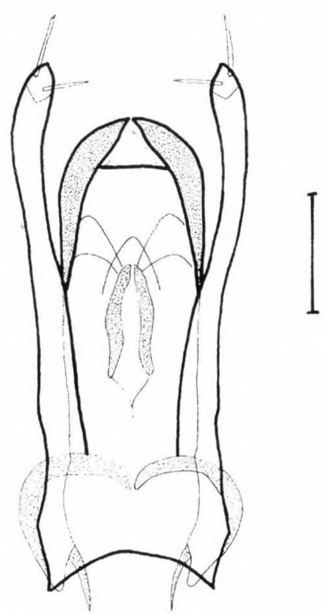
Head. Densely, distinctly punctate, punctures separated by 2–3 times their diameters. Interstices without microsculpture. Two shallow impressions between eyes present. Clypeal line lacking. Clypeus slightly roundly emarginate. Groove forming anterior margin of clypeus running closely parallel with outline (Fig. 1). Antennal club oval. Length ratio of club segments 7th to 11th (7th = 1.0, 8th not visible) = 1.0 – not visible – 1.4 – 1.4 – 1.6; width ratio 1.0 – not visible – 1.3 – 1.4 – 1.0. Width ratio / length of club segment = 2.4 – unknown – 2.2 – 2.3 – 1.5.

Pronotum. Much finer and sparser punctate as head, punctures irregularly distributed, separated by about 4–6 times their diameters. Punctation becoming denser toward base. Interstices without microsculpture. Maximum width at base, posterior angles sharp, prominent posteriorly, acute in dorsal view. Base not emarginate at hind angles. In lateral view, posterior angles blunt, broadly rounded.

Scutellum. Punctate as pronotum, interstices smooth.

Elytra. With puncture rows. Punctures in rows large, dense, separated by their diameters, punctures sparser toward base, separated by 2–4 times their diameters. Interstices smooth. Rows





Figs 1–2. *Zeadolopus merkli* sp. n., holotype, male: 1 = head, 2 = aedeagus in dorsal view. Scale bars = 0.1 mm

reaching base except for shortened 7th and 8th. Intervals very finely punctate. Punctures separated by 3–5 times their diameters. Odd-numbered intervals with sparsely distributed large punctures as large as those in rows. Lateral margin of elytra with row consisting of about 10 larger punctures becoming smaller toward apex. The first puncture is the biggest, twice as large as punctures in rows. First row of punctures becoming sutural stria in posterior third of elytra.

Metasternum. With foveae and large punctures as in Fig. 3. Sides longitudinally microsculptured.

Wings fully developed.

Abdominal sterna. First visible sternite without microsculpture, with a row of large foveae near anterior margin as in Fig. 3.

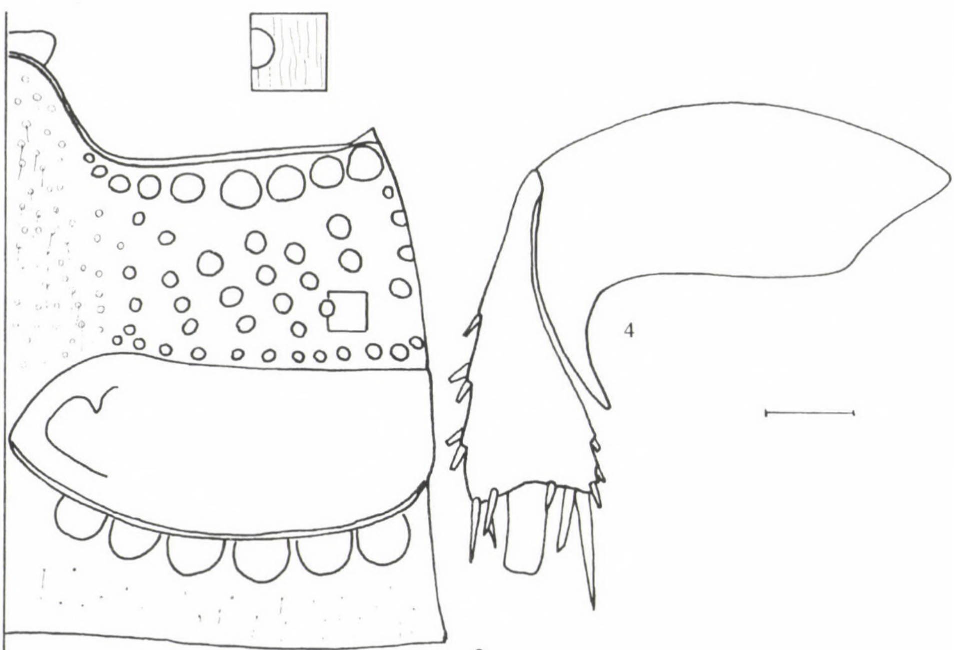
Legs. Middle and hind tibiae very broad, as typical in the genus. Hind leg of male as in Fig. 4.

Genitalia. Aedeagus as in Fig. 2.

Bionomy – Not known. The single specimen was collected by a flight intercept trap erected at the edge of degraded mountain rainforest.

Etymology – The new species is dedicated to its collector, Dr. OTTÓ MERKL, HNHM, Budapest.

Diagnosis: *Zeadolopus merkli* sp. n. is similar to *Z. globus* DAFFNER, 1983 and *Z. fulvus* DAFFNER, 1983 in the elytral puncture rows reaching base, by the presence of fovea-like punctures on metasternum, on the first visible sternite and at the elytral edges. The new species differs from them by the arrangement of the large punctures on the metasternum. While the metasternal punctures are ar-



Figs 3–4. *Zeadolopus merkli* sp. n., holotype, male: 3 = metasternum and first visible abdominal sternite, 4 = hind femur and tibia of male. Scale bars = 0.1 mm

ranged in a single row anteriorly and in two oblique rows running posteriorly in *Z. globus*, those punctures are arranged in one row at the anterior part of the metasternum in *Z. merkli*. Somewhat smaller punctures cover the remaining lateral parts of the metasternum in the species mentioned. Large punctures are arranged at anterior and posterior margin of the metasternum only in *Z. fulvus*. The shape of the aedeagus of *Z. merkli* is also different.

Three species originally described in the genus *Cyrtusa* are herewith transferred to the genus *Zeadolopus*. The main characters separating these two genera are the arrangement of the antennal club and the shape of the tibiae. While the antennal club is formed by five clearly visible segments in *Cyrtusa*, the same in *Zeadolopus* is obviously four-segmented because the 8th segment is not visible. The tibiae are not modified in *Cyrtusa* while those are strongly dilated in *Zeadolopus*. All the characters typical for *Zeadolopus* are clearly expressed in the original descriptions and on the drawings added to the descriptions. The three following species are therefore transferred from *Cyrtusa* to *Zeadolopus*.

Zeadolopus freyanus (HLISNIKOVSKY, 1968) **comb. n.**

Cyrtusa freyana HLISNIKOVSKY, 1968: 146.

The original description and the drawing of the antenna given by HLISNIKOVSKY (1968: Fig. 3) show that the species undoubtedly belongs to the genus *Zeadolopus*.

Distribution – Nigeria.

Zeadolopus serrativentris (CHAMPION, 1925) **comb. n.**

Cyrtusa serrativentris CHAMPION, 1925: 8.

The original description and the drawing of the hind leg given by CHAMPION (1925: Fig. 1g) show that the species undoubtedly belongs to the genus *Zeadolopus*.

Distribution – Zimbabwe.

Zeadolopus conicitarsis (CHAMPION, 1925) **comb. n.**

Cyrtusa conicitarsis CHAMPION, 1925: 9.

The original description and the drawing of hind leg given by CHAMPION (1925: Fig. 1f) indicate that the species is undoubtedly a member of the genus *Zeadolopus*.

Distribution – Antilles (Grenada).

Zeadolopus ventriculus sp. n.
(Figs 5–9)

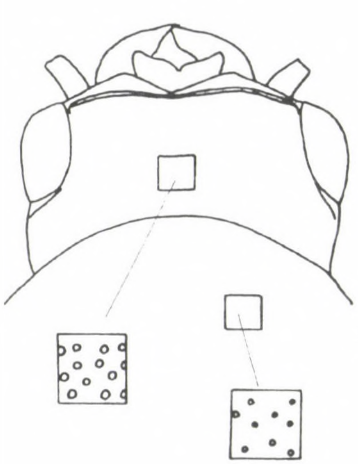
Type material – Holotype, male: Ethiopia, Yamba, IX. 1983. Paratype, female: same data. Both are deposited in the author's collection.

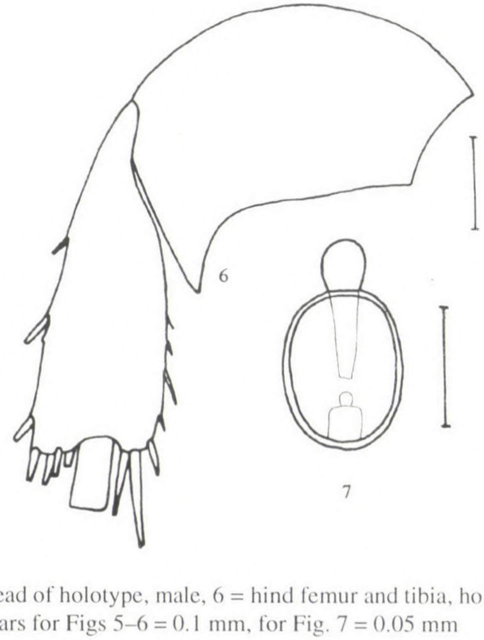
Description – Reddish yellow, posterior margin of pronotum and suture brown, tip of right mandible black. Underside reddish brown, margins of cavities of middle and hind coxae darker.

Length of body 2.1 – 2.2 mm, in holotype 2.1 mm, head 0.4 mm, pronotum 0.6 mm, elytra 1.1 mm, antenna 0.5 mm. Maximum width of head 0.6 mm, pronotum 1.1 mm, elytra 1.2 mm.

Head. Strongly, densely punctate, punctures separated by 1 times their diameters. Interstices without microsculpture. Clypeal line lacking. Clypeus triangularly emarginate in the middle, its sides produced forward. Groove forming anterior margin of clypeus lets triangular small plates at each side of clypeus as in Fig. 5. Antennal club oval. Length ratio of club segments 7th to 11th (7th = 1.0, 8th not visible) = 1.0 – not visible – 1.0 – 1.3 – 2.2; width ratio 1.0 – not visible – 1.3 – 1.4 – 1.2. Width ratio/ length of club segment = 2.2 – unknown – 2.8 – 2.4 – 1.2.

Pronotum. Finer and sparser punctate as head, punctures irregularly distributed, separated by about 3–5 times their diameters. Punctation becoming denser toward base. Interstices without microsculpture. Maximum width at base, posterior angles sharp, projecting posteriorly, acute in dorsal view. Base distinctly emarginate at hind angles. In lateral view, posterior angles blunt, broadly rounded.


5


6

7

Figs 5–7. *Zeadolopus ventriculus* sp. n.: 5 = head of holotype, male, 6 = hind femur and tibia, holotype, male, 7 = spermatheca, paratype. Scale bars for Figs 5–6 = 0.1 mm, for Fig. 7 = 0.05 mm

Scutellum. Punctate as pronotum, interstices smooth.

Elytra. Without puncture rows. Punctures dense, larger and denser as on pronotum, separated by about 1–3 times their diameters, interspersed by one minute, very fine, punctures. Interstices smooth. Lateral margin of elytra with row of punctures as large as others on elytra. Sutural stria reaching middle of elytra.

Metasternum. Without foveae and fovea-like large punctures; puncturation coarse, regular, distinct, dense as in Fig. 8. Sides longitudinally microsculptured.

Wings fully developed.

Abdominal sterna. First visible sternite without row of large foveae at anterior margin. Punctures on first visible sternite shallow, as in Fig. 8. Microsculpture consisting of transverse cells.

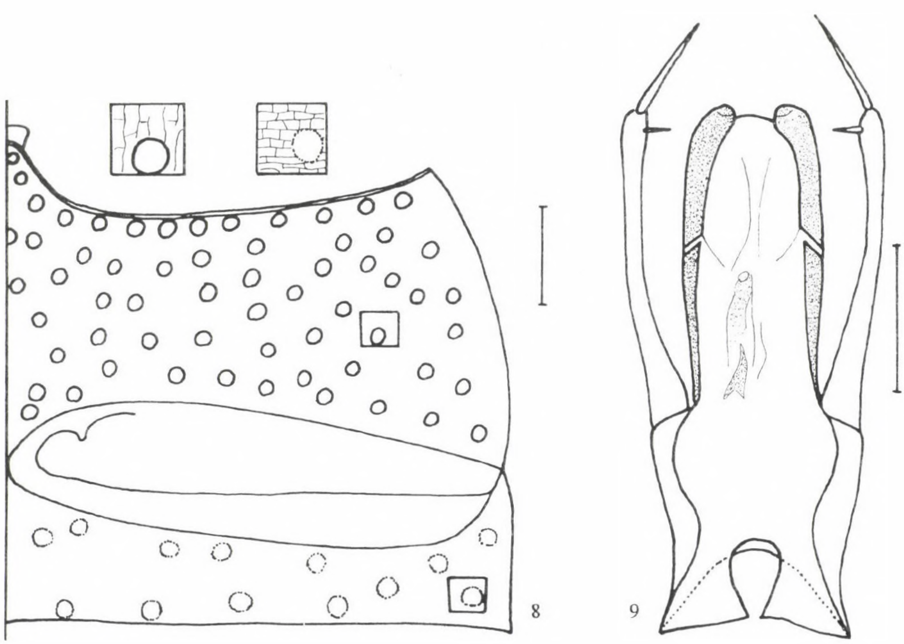
Legs. Middle and hind tibiae tibiae very broad, as typical in the genus. Hind leg of male as in Fig. 6.

Genitalia. Aedeagus as in Fig. 9, spermatheca as in Fig. 7.

Bionomy – Not known.

Etymology – The name is derived from the short oval shape of the body.

Diagnosis: *Zeadolopus ventriculus* sp. n. is similar to *Z. freyanus* (HLISNIKOVSKY, 1968) with which it shares the absence of elytral rows of punctures. It differs from *Z. freyanus* by the character of absence of row of large fovea-like punctures at anterior margin of first visible abdominal sternite.



Figs 8–9. *Zeadolopus ventriculus* sp. n.: 8 = metasternum and first visible abdominal sternite, 9 = aedeagus in dorsal view. Scale bars = 0.1 mm

KEY TO AFRICAN SPECIES OF ZEADOLOPUS MODIFIED AFTER HLISNIKOVSKY (1966, 1968)

(*Cyrtusa rohani* PORTEVIN, 1937 of uncertain status is included)

1 First visible abdominal sternite without row of large punctures at anterior margin, punctures of normal size, irregularly distributed. Elytra without rows of punctures. 2.1–2.2 mm. Ethiopia. *Zeadolopus ventriculus* sp. n.

– First visible abdominal sternite with row of large punctures at anterior margin 2

2(1) Elytra without rows of punctures. Metasternum regularly and densely punctate, without conspicuous, large punctures or foveae. 2.0–2.2 mm. Nigeria. *Zeadolopus freyanus* (HLISNIKOVSKY, 1968)

– Elytra with rows of punctures or with punctate striae 3

3(2) Elytra with well-defined rows of punctures. Metasternum densely and coarsely punctate at sides, densely and finely punctate on raised central part. 1.25 mm. Zimbabwe. *Zeadolopus serrativentris* (CHAMPION, 1925)

– Elytra with hardly visible punctate striae. 1.8–2.0 mm. Angola. *Cyrtusa rohani* PORTEVIN, 1937

CHECKLIST OF THE SPECIES OF THE GENUS ZEADOLOPUS BROUN, 1903

*Z. ammophilus (L*EA, 1911) – Tasmania
Z. australis (CHAMPION, 1925) – Australia
Z. bakewelli (CHAMPION, 1925) – Australia
Z. bengalicus DAFFNER, 1983 – India
Z. besucheti DAFFNER, 1983 – India
Z. bicolor (PECK, 1978) – Jamaica
Z. bicoloriclavus (LEA, 1911) – Tasmania
Z. bifoveolatus DAFFNER, 1989 – USA
Z. biroanus (HLISNIKOVSKY, 1964) – Papua New Guinea
Z. chaosicus DAFFNER, 1983 – Korea
Z. confectus (WALKER, 1858) – Srí Lanka
Z. conicitarsis (CHAMPION, 1925), **comb. n.** – Antilles (Grenada)
Z. egenus (LECONTE, 1853) – Canada, USA
Z. freyanus (HLISNIKOVSKY, 1968), **comb. n.** – Nigeria

Z. fulvus DAFFNER, 1983 – India
Z. globus DAFFNER, 1983 – India
Z. guineensis (HLISNIKOVSKY, 1964) – Papua New Guinea
Z. inflatipes (REITTER, 1891) – Caucasus, Turkmenistan, Mongolia
Z. insularis (HLISNIKOVSKY, 1966) – Bismarck Archipelago
Z. jamaicensis (PECK, 1977) – Jamaica
Z. japonicus (CHAMPION, 1925) – Japan
Z. latipes (ERICHSON, 1845) – Europe, Caucasus
Z. maoricus DAFFNER, 1985 – New Zealand
Z. merkli **sp. n.** – Malaysia
*Z. microps (*PECK, 1977) – Jamaica
Z. micropunctatus (LEA, 1911) – Australia
Z. minimus DAFFNER, 1983 – India
Z. multipuctatus DAFFNER, 1983 – India
Z. myrmecophilus (LEA, 1910) – Tasmania
Z. nanulus DAFFNER, 1982 – India
Z. oklahomensis DAFFNER, 1989 – USA
Z. parvulus (HLISNIKOVSKY, 1966) – Bismarck Islands
Z. piceatus (HLISNIKOVSKY, 1972) – Srí Lanka
Z. puertoricensis (PECK, 1977) – Puerto Rico
Z. punctaticollis DAFFNER, 1985 – Papua New Guinea
Z. razumovskii PERKOVSKY, 1990 – Russia (Far East)
Z. rubricornis DAFFNER, 1989 – USA
Z. sedlaceki DAFFNER, 1985 – Papua New Guinea
Z. serrativentris (CHAMPION, 1925), **comb. n.** – Zimbabwe
Z. sinensis (PORTEVIN, 1942) – China
Z. spinipes BROUN, 1903 – New Zealand
Z. tantillus DAFFNER, 1985 – Papua New Guinea
Z. tasmaniae (OLLIFF, 1889) – Tasmania
Z. turgidus DAFFNER, 1982 – India
Z. validipes DAFFNER, 1985 – New Zealand
Z. ventriculus **sp. n.** – Ethiopia
Z. wiburdi (LEA, 1911) – Australia

Dermatohomoeus hamatus sp. n.
(Fig. 10)

Type material – Holotype, male: Indonesia, Kalimantan Barat, Gunung Palung Nat. Park, Cabang Panti research site, 1°13'S, 110°7'E, lowland rainforest, at light, No. 9, 18.–26.VII. 1993, O. MERKL [lgt.]. It is deposited in the HNHM. Paratypes, two females: same data (HNHM); one male, same data, deposited in the author's collection.

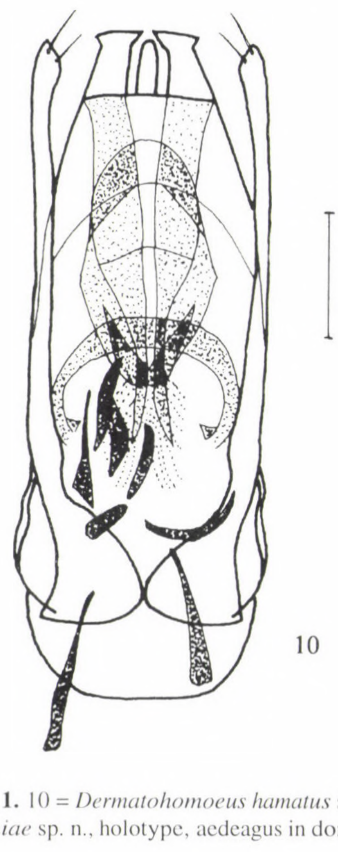
Description – Red to reddish brown, antennae and legs red. Underside red, metasternal process and raised part of mesosternum reddish brown, margins of metasternum as well as middle and hind coxae brown.

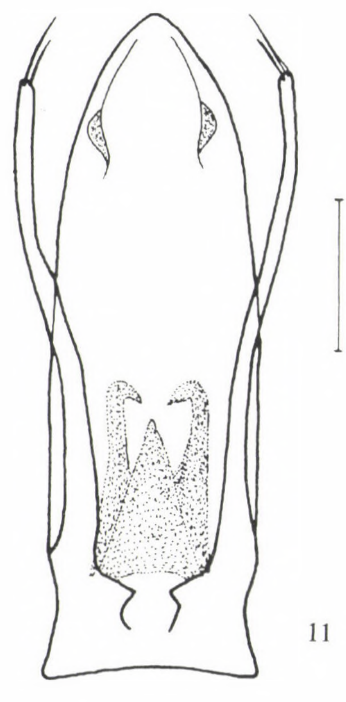
Length of body 1.2–1.5 mm, in holotype 1.4 mm, head 0.10 mm, pronotum 0.40 mm, elytra 0.90 mm, antenna 0.50 mm. Maximum width of head 0.40 mm, pronotum 0.90 mm, elytra 0.90 mm (just behind basis). Height of pronotum 0.60 mm, elytra 0.60 mm.

Head. Distinctly punctate, punctures irregularly distributed, separated by 2–6 times their diameters. Punctation becoming denser toward eyes and vertex. Interstices without microsculpture. Length ratiof of head/eyes = 1/0.66, eyes about 1.5 times as broad as second antennal segment. Clypeal line slightly developed, superficial. Length ratio of second and the following antennal segments (2nd segment = 1.0) = 1.0 – 1.1 – 0.8 – 0.5 – 0.4 – 0.8 – 0.4 – 0.8 – 0.8 – 1.4. Maximum width ratio of antennal club segments (7th segment = 1.0) = 1.0 – 0.6 – 1.2 – 1.2 – 1.6.

Pronotum. Punctation finer than on head. Interstices without microsculpture. Punctures small, bearing short and fine hairs, separated by about 5–6 times their diameters. Anterior margin bordered, basal margin unbordered, straight, weakly emarginate at hind angles. Hind angles acute-angled, shortly rounded in dorsal view, slightly obtuse in lateral view.

Elytra. Whole elytra with strigosity formed by transverse wrinkles, distance between them about 0.03 mm. Surface distinctly punctate, punctures bearing short pale hairs. Punctures forming somewhat irregular double rows. Each couple of rows separated by about 3 times of puncture diameters. Each interval placed between two adjacent couples of punctate rows with single row of finer punctures. Sutural stria short, reaching middle of elytra.


10


11

Figs 10–11. 10 = *Dermatohomoeus hamatus* sp. n., holotype, aedeagus in dorsal view, 11 = *Colenisia tanzaniae* sp. n., holotype, aedeagus in dorsal view. Scale bars = 0.1 mm

Meso- and metasternum. Margin of mesosternal carina slightly bent, nearly straight in lateral view. Metasternum microsculptured by oblique elongate cells except for smooth part above hind coxae. Central raised part of metasternum without microsculpture, covered by distinct, dense punctures, separated by about 1–2 times their diameters.

Wings fully developed.

Abdominal sterna. Without striking characters.

Legs. Without striking characters. First and second segments of fore tarsi slightly dilated in males.

Genitalia. Aedeagus as in Fig. 10, female genitalia not examined.

Bionomy – Not known. The type specimens were collected at light in pristine lowland rainforest.

Etymology – The name of the new species is derived from the hooked shape of distal part of aedeagus.

Diagnosis: *Dermatohomoeus hamatus* sp. n. is similar to *D. silvaticus* (HLISNIKOVSKY, 1972) in having large eyes, emarginate base of pronotum at the hind angles, antennae longer than length of pronotum and sparsely punctate elytra. The new species differs from *D. silvaticus* by the much more sparsely punctate head and pronotum and mainly by the shape of aedeagus, which is double-hooked distally, while the aedeagus is simply pointed at the apex in *D. silvaticus*.

Colenisia tanzaniae sp. n.
(Fig. 11)

Type material – Holotype, male: Tanzania, Tanga reg., Amani, singled, No 149, 18.II.1987, S. MAHUNKA & A. ZICSI [lgt.] Deposited in the HNHM. Paratype, male: same data, deposited in the author's collection.

Description. – Reddish brown, pronotal and elytral margins, first to sixth antennal segments and legs yellowish red, antennal club reddish brown in holotype, red in paratype. Underside reddish yellow, metasternal process, raised part of mesosternum as well as middle and hind coxae reddish brown.

Length of body 1.3 mm, head 0.20 mm, pronotum 0.30 mm, elytra 0.80 mm, antenna 0.40 mm, maximum width of head 0.40 mm, pronotum 0.80 mm, elytra 0.80 mm (just behind basis). Height of pronotum 0.40 mm, elytra 0.40 mm.

Head. With microsculpture formed by very elongate irregular transverse cells looking like strigosity. Distance between elements of strigosity about 0.01 mm. Punctation sparse, superficial, extremely fine, punctures separated by 6–10 times their diameters. Vertex with two large punctures situated at level of hind margin of eyes. Eyes large, as long as last antennal segment. Clypeal line slightly developed, superficial. Length ratio of second and all following antennal segments (2nd segment = 1.0): 1.0 – 1.0 – 0.3 – 0.3 – 0.3 – 0.8 – 0.3 – 0.6 – 0.6 – 1.5. Maximum width ratio of antennal club segments (7th segment = 0.1): 1.0 – 0.8 – 1.3 – 1.3 – 1.3.

Pronotum. Microsculpture and puncturation as on head. Punctures very small, superficial and rare, bearing very short and fine hairs, separated by about 8–10 times their diameters. Basal and anterior margin of pronotum unbordered. Hind angles acute-angled, shortly rounded in dorsal view, slightly obtuse in lateral view.

Elytra. Whole elytra with strigosity formed by transverse wrinkles, the distance between them about 0.02 mm. Surface distinctly and finely punctate, punctures bearing short pale hairs.

Punctures forming irregular rows near suture and with tendency to form irregular rows on disc. Puncturation sparse, punctures separated by 4 times their diameters in average. Sutural striae short, reaching apical fifth of elytra.

Meso- and metasternum. Mesosternal carina low, its margin straight with slightly developed short emargination in middle in lateral view. Metasternum microsculptured laterally by oblique elongate cells, central part of metasternum raised, covered by distinct, sparsely distributed punctures separated by about 5–6 times their diameters.

Wings fully developed.

Abdominal sterna. Without striking characters.

Legs. Without striking characters, First to third segments of fore tarsi slightly dilated in male.

Genitalia. Aedeagus as in Fig. 11, female genitalia unknown.

Bionomy – Not known.

Etymology – The name of the new species is derived from the name of the country of the type locality.

Diagnosis: *Colenisia tanzaniae* sp. n. seems to be closest to *C. muehleiana* DAFFNER, 1987. Both species are characterized by similarly microsculptured dorsal surface and large eyes. They differ in the shape of aedeagus which is simply narrowed toward the shortly rounded apex in *C. tanzaniae*, while the aedeagus is contracted before the apex in *C. muehleiana*. Both species differ also in the colour of the dorsal surface. The African species of *Colenisia* were keyed by DAFFNER (1987). The new species could be included in the key as follows:

3 Strigosity of elytra well-developed, sparse 3

– Strigosity of elytra fine, dense 4

3 Blackish brown, aedeagus constricted before apex. 1.1–1.3 mm. Rwanda *Colenisia muehleiana* DAFFNER, 1987

– Reddish brown, sides of aedeagus simply narrowed toward apex. 1.5 mm. Tanzania *Colenisia tanzaniae* sp. n.

* * *

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THE PALAEARCTIC SPECIES OF AULACIGASTER MACQUART (DIPTERA: AULACIGASTRIDAE)

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Two new species of the genus *Aulacigaster* MACQUART, 1835, *A. falcata* sp. n. (Hungary, Croatia) and *A. afghanorum* sp. n. (Afghanistan, Kabul), are described and the Nearctic *A. neoleucopeza* MATHIS et FREIDBERG, 1994, is reported from Hungary. With 21 original figures.

Key words: Aulacigaster, new species, taxonomy, Palaearctic Region

THE GENUS AULACIGASTER MACQUART, 1835

Sometime about 1990, while sorting unnamed material in the Diptera Collection of the Hungarian Natural History Museum, Budapest, it became apparent that "something was wrong" with the species *Aulacigaster leucopeza* (MEIGEN, 1830), then the only known Palaearctic species. My desire to revise the Palaearctic species was much facilitated by the papers of BARRACLOUGH (1993) on the Afrotropical species of *Aulacigaster*, and of MATHIS and FREIDBERG (1994) on the Nearctic species, respectively. The study of insect guilds on "very small feeding sources" (droppings of forest animals, dead snails, dead mice, decaying fungi, oozing sap of deciduous woods etc.), made it possible to collect numerous *Aulacigaster* specimens on sap runs on deciduous trees in Hungary during the last three years (c. twice as many as the whole previous collection in the HNHM. Finally, the preparation of the aulacigastrid chapter in the new "Contributions to a Manual of Palaearctic Diptera" required a clearer picture of the species occurring there.

The initial problem with *Aulacigaster* species is that most of the differences are in the male genitalia, which are rather intricate structures. Their main parts are (cf. TESKEY 1987, BARRACLOUGH 1993: Figs 3–4): well-formed though not strongly sclerotized cerci; subepandrial sclerite, with caudal part attached to cerci; surstyli fused to epandrium; long aedeagal apodeme fused to the membraneous aedeagus in a comparatively long sagittal section (Fig. 18, actually apodeme fused to phallophore); hypandrium and gonopods fused into a wide showel-like structure (Fig. 17), with ventral and particularly ventroapical parts weakly sclerotized, lacking definite shape after preparation; free part of hypandrium

directed anteriorly as a pair of long processes; gonopods embracing phallophore (gonopods extended medially and fused in the sagittal line), and joining to it *dorsally* but a caudal connection also is somewhat sclerotized; membraneous caudal parts as an additional process *in lateral view*. BARRACLOUGH's "lateral apodeme" is actually the hypandrium. His "parameres" cannot be true parameres, since they do not directly join aedeagus.

Below the hand-written label data are given in quotation marks, my own annotations of the label data are in square brackets. The specimens are deposited in the Diptera Collection of the Department of Zoology, Hungarian Natural History Museum, Budapest, unless stated otherwise.

Aulacigaster afghanorum sp. n.
(Figs 1, 3, 6, 9)

Holotype male (HNHM): Afghanistan: Kabul, Aliabad, University Park; 21 April 1974, leg. L. PAPP, No. 49 ["singled on oozing sap of Salix and Populus trees"].

Paratypes (HNHM): 9 males, 10 females: same data as holotype (1 indiv. (?female) was not labelled as paratype, since it is without abdomen); 6 males, 3 females: ibid., 1–2 June, No. 143a ["singled on oozing sap of Morus alba and Populus alba"]; 1 female: ibid., 9–11 April, No. 16 ["singled"]; 1 female: Prov. Parwan: Estalef, 2000 m, 15 April 1974, No. 33 ["singled on sap of Morus alba"].

Measurements in mm: body length 2.50 (holotype), 1.63–2.65 (paratype males), 1.95–2.75 (paratype females), wing length 2.54 (holotype), 1.88–2.80 (paratypes), wing width 1.03 (holotype), 0.78–1.10 (paratypes).

Mesonotum and abdomen (also mainly pleurae) dark brown covered with thick grey microtomentum, humeral area yellow.

Orange transverse band on frons broader than half distance of lunule to fore ocellus. Posterior half of frons (beside ocellar triangle, caudal to orbital bristles) shiny.

Reduced ocellar setae longer, length c. equal to distance of anterior and posterior ocelli. Additional small acrostichals between medial rows and dorsocentral lines, plus acrostichals tending to be biserial. Humeral callus yellow.

Epandrium with numerous, comparatively long setae (Fig. 1). Cerci long broad with dense long cilia but without any longer setae. Subepandrial sclerite (Fig. 9) with long and very broad caudal part. Male surstylus long but blunt (Fig. 1, 6) with rounded apex. Gonopods (Fig. 3) ventrally with a number of medium long setae. Details of gonopods, ventral process, hypandrium and aedeagus different from those of *falcata*.

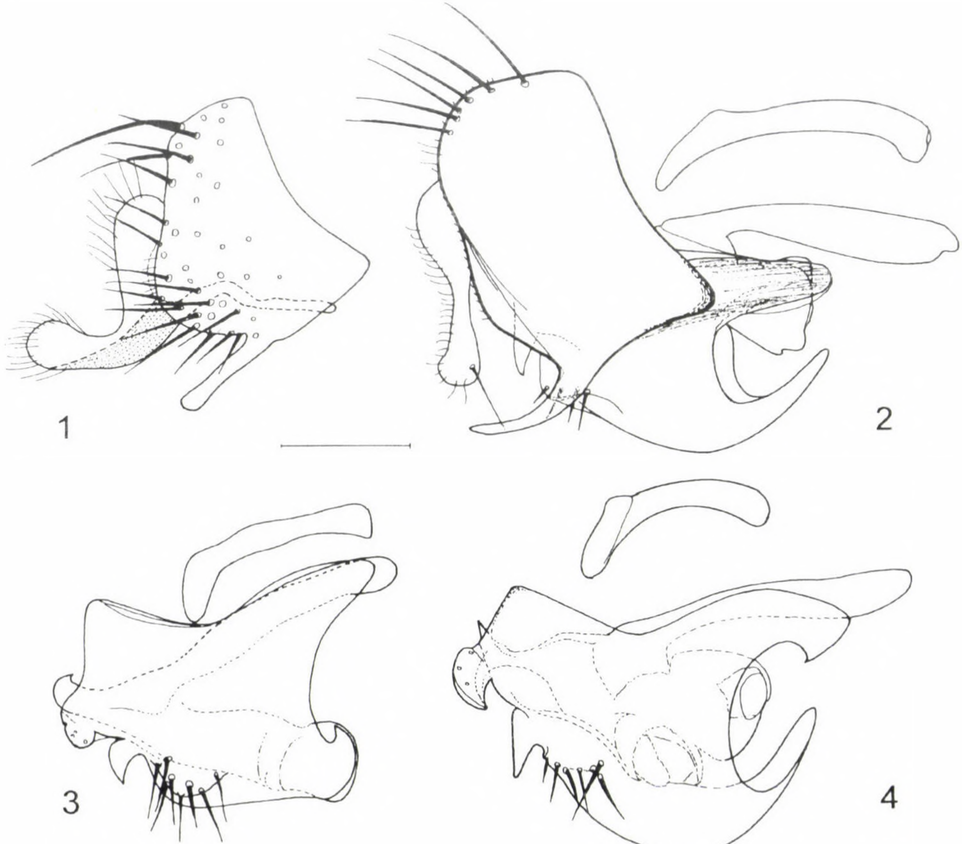
Female terminalia without peculiar characters.

Aulacigaster falcata sp. n.
(Figs 2, 4, 8, 10)

Holotype male (HNHM): Hungary: K[iskunsági] N[ational] P[ark], Kunfehértó, 1982. VII. 15 – leg PAPP L.

Paratypes: 5 males, 2 females (1 male USNM): same data as for the holotype; 1 female: Gyón Kertész [reverse side] 1918. VI. 19. – "A. leucopeza Mg. ♀" Det. O. Duda – "Aulacigaster

leucopeza Mg." det. Aradi; 4 males: Budapest Kertész [reverse side] "1917.VI. 25." – "leucopeza Mg. ♂" Det. O. Duda [on all 4 indiv.; on one of them:] "Aulacigaster leucopeza Mg." det. Aradi; 1 female: Börzsöny-hg. [Verőce] Magyarkút – 1957. VII. 10–13., leg. Székessy; 1 male: Aranyosgadány – tölgyfa kicsorgó nedvéről [on outflowing sap of an oak tree] – 1971. IV. 9., leg PAPP L.; 1 male: ibid., tölgyfa kicsorgó nedve [on outflowing sap of an oak tree], 1971. V. 17., kelt [emerged] 1971. V. 31.; 1 male: Kállósemjén, 1966. IX. 10. – fénycsapda [light-trap]; Budapest, Pestszentlőrinc, Péterhalmi-erdő, leg. PAPP L.: 1 male and 1 female [in copula]: szilfa sebéről [on wounds of hornbeam trees], 1996. IV. 20–22.; 6 males, 13 females (1 female USNM): szilfák sebeiről [on wounds of hornbeam trees] 1995. VIII. 5., 1996. V. 11–12., VI. 15–16., VI. 21., VI. 22., VI. 25., VII. 7–11., 1997. IV. 20.; 1 female: sebes szilfa kérgéből nevelve [reared from bark of a wounded hornbeam], 1996. VI. 25–26.; 1 male: eperfa sebéről [on wound of a *Morus* tree], 1996. VII. 14.; 1 male, 1 female: nyírfa sebéről [on wound of a *Betula* tree], 1994. VII. 24.; 1 male: tölgy nedvén [on sap of an oak], 1995. IV. 23. Croatia: 1 male: Crkvenica "25.VI." – "Aulacigaster leucopeza Mg." det. Aradi.



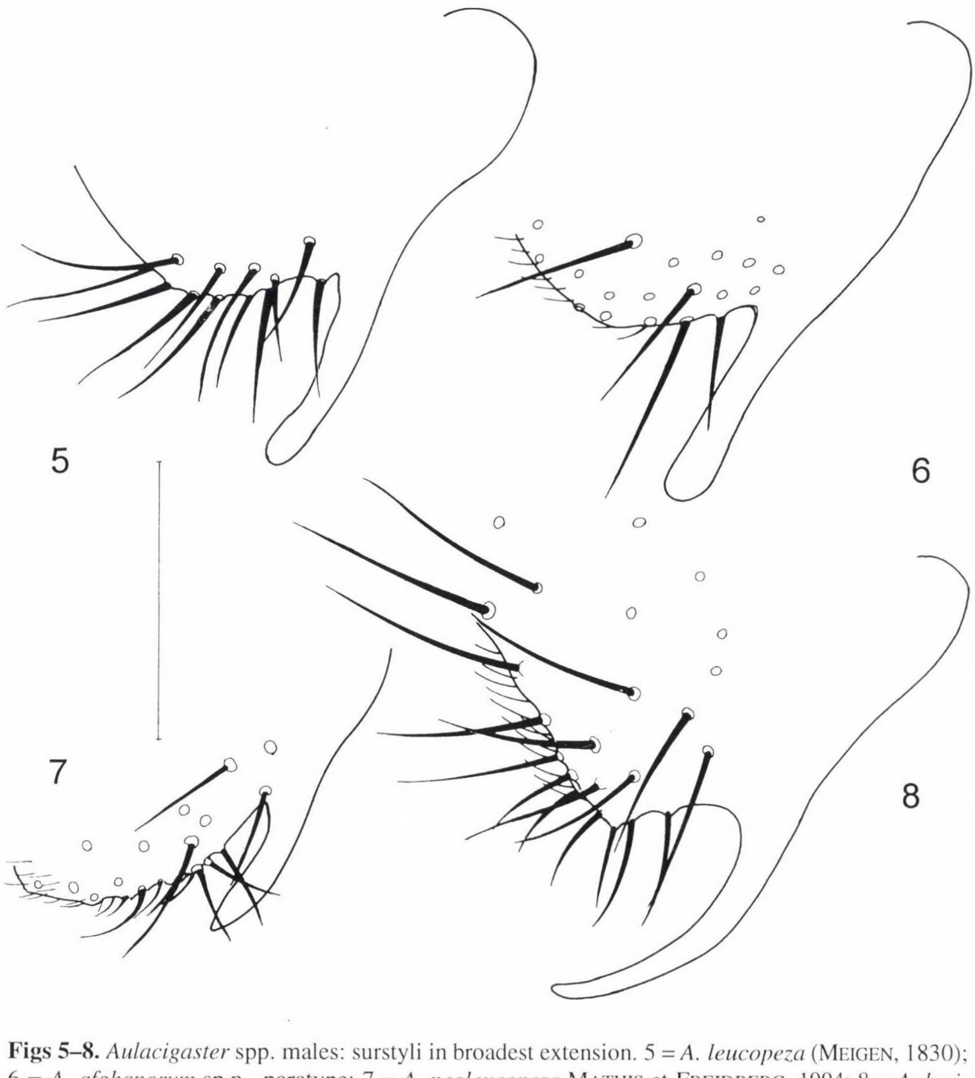
Figs 1–4. *Aulacigaster* spp., male genitalia laterally. 1 = *A. afghanorum* sp. n., paratype, epandrium, surstylus and cercus (caudal part of subepandrial sclerite dotted); 2 = *A. falcata* sp. n., genital complex with epandrium, etc.; 3 = *A. afghanorum* sp. n., paratype, gonopod and aedeagal complex; 4 = *A. falcata* sp. n., paratype, gonopod with aedeagal complex. Scale: 0.1 mm for all

Measurements in mm: body length 2.46 (holotype), 1.92–2.50 (paratype males), 2.29–2.71 (paratype females), wing length 2.58 (holotype), 2.17–2.88 (paratypes), wing width 1.05 (holotype), 0.80–1.07 (paratypes).

Body dark brown with light grey microtomentum.

Orange frontal transversal band very broad, broader than half distance of lunule to fore ocellus. Posterior half of frons (beside ocellar triangle) shiny but caudal to orbital bristles with narrow microtomentose orbital margins.

Humeral callus yellowish. Anepisternum medially with diffuse light colour (a diffuse band) from base of fore coxae to anepisternal bristles. Almost all katepisternum bare to level of humeral bristle. Acrostichals tending to be biserial. No acrostichals between medial rows and dorsocentral lines.



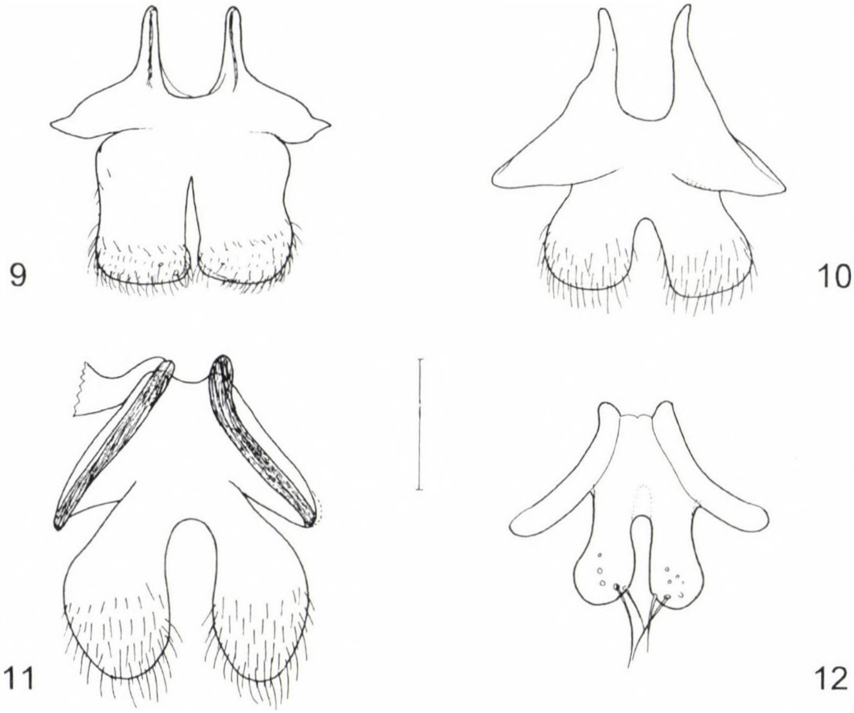
Figs 5–8. *Aulacigaster* spp. males: surstyli in broadest extension. 5 = *A. leucopeza* (MEIGEN, 1830); 6 = *A. afghanorum* sp.n., paratype; 7 = *A. neoleucopeza* MATHIS et FREIDBERG, 1994; 8 = *Aulacigaster falcata* sp.n., paratype. Scale: 0.1 mm for all

Male genitalia with extremely long straight (and rather dense) setae on epandrium (Figs 2, 8), similarly to that of *A. afghanorum*. Cerci rather long but shorter than in afghanorum (Fig. 2), also caudal part of subepandrial sclerite shorter and less broad than that of *afghanorum* (Fig. 10). Male surstylus long and sickle-shaped (Figs 2, 8). Caudal (rather membraneous) process of aedeagal complex better formed (Fig. 4). Details of gonopods, hypandrium, aedeagal apodeme etc. different from those of the closely related *afghanorum* (Fig. 4, cf. Fig. 3).

I found no truely different characters when comparing *falcata* and *afghanorum* females. However, since the males are so definitely different in genital characters, it is possibly only a question of time and patience to find such female characters.

Aulacigaster leucopeza MEIGEN, 1830
(Figs 5, 11, 13, 15–16, 18–20)

Material studied (HNHM): more than 320 specimens mainly from various parts of Hungary (including several pairs caught in copula); however, also from Romania (Mehadia), Slovakia (Bártfa = Bardejov), eastern Germany (Frankfurt a. O., Riedel's coll.) and Austria (coll. Pokorny).



Figs 9–12. *Aulacigaster* spp. males: subepandrial sclerite in ventral view. 9 = *A. afghanorum* sp.n., paratype; 10 = *A. falcata* sp.n., paratype; 11 = *A. leucopeza* (MEIGEN, 1830); 12 = *A. neoleucopeza* MATHIS et FREIDBERG, 1994. Scale: 0.1 mm for all

Body characteristics are repeatedly described in the literature; almost the same as in *A. neoleucopeza* MATHIS et FREIDBERG, 1994. It was decisive to find differentiating character(s) other than male genitalia in identifying females (and also to save time in separating males without genitalia preparation). The size of the bare spots lateral to the ocellar triangle is a reliable character. Of course, differences in the male genitalia are always important. Epandrium with sparse setae only, particularly so dorsally. Cerci and caudal part of subepandrial sclerite (Figs 15, 11) large and broad but without long setae, surstylus long digitiform (Figs 5, 15), gonopods ventrally with numerous medium long setae (Figs 15–16).

Submarginal lateral setae of female 8th sternite (Fig. 19) are somewhat shorter than in *neoleucopeza* but this difference does not seem to be sufficient to separate them. Spermathecae (Fig. 20) largely cylindrical, more than spherical, apical half with fine annulation.

All the specimens in the HNHM were identified during the course of the present study and genitalic preparation were made of several specimens (incl. pairs in copula).

MATHIS and FREIDBERG (1994) reported *leucopeza* from England, France, Germany, Hungary, Israel, Italy, Poland, Spain (Canary Is.: La Palma [!]) and Sweden. All these are important records, since the specimens were identified during the studies of the Nearctic *Aulacigaster* species in comparison with *leucopeza.*

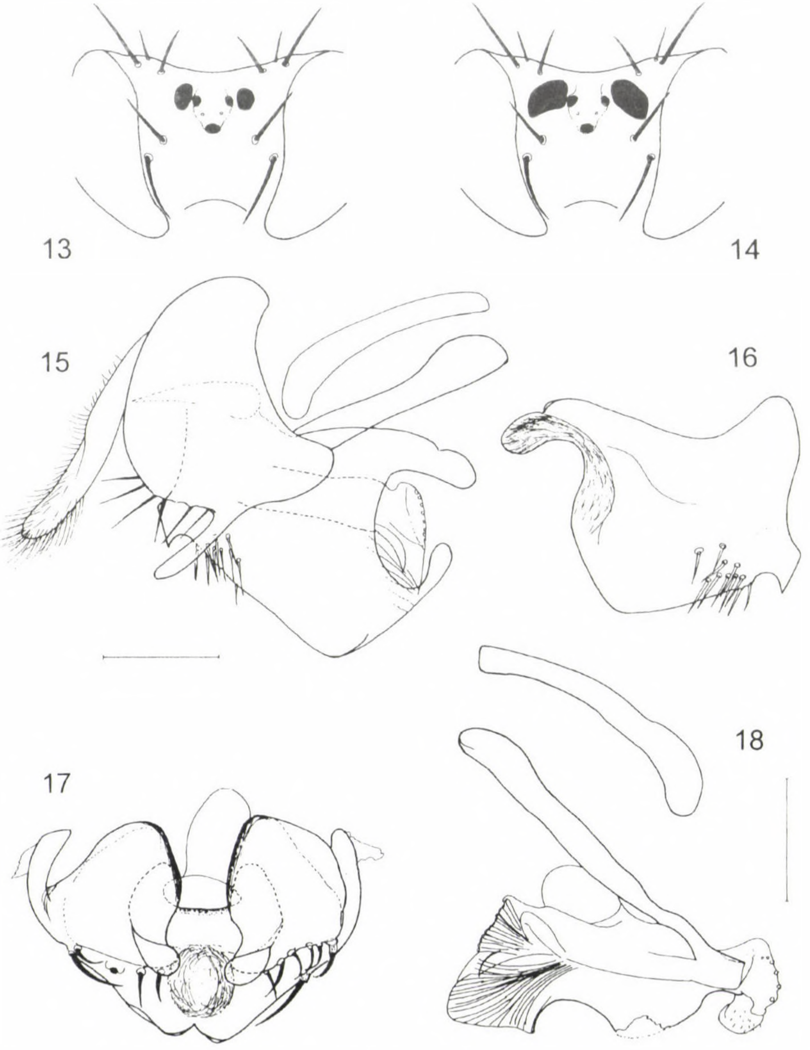
I studied the only female specimen in the HNHM that I had previously reported from N Korea (PAPP 1974: Prov. Ryang-gang, Chann-Pay plateau, Samzi-yan). Unfortunately the female is not identifiable, although I suspect that it belongs to an undescribed species in the *leucopeza-neoleucopeza* group (only bare spot laterally to ocellar triangle, acrostichals uniserial etc.). It may be conspecific with the specimens that Duda (1934) reported from the Ussuri Mountains (preserved in the St. Petersburg Museum). A study of these specimens may resolve the question.

Formerly only this species was reported from the Palaearctic Region (PAPP 1973, 1984, 1988, and numerous other authors). It is a matter of course that these records need revision. Larvae of *A. afghanorum, A. falcata, A. leucopeza* are in the collection of the HNHM. The differentiating characters of the larvae are also to be found in the near future (cf. also ROBINSON 1953, TESKEY 1976).

Aulacigaster neoleucopeza MATHIS et FREIDBERG, 1994 (Figs 7, 12, 14, 17, 21)

Material studied: Paratypes (USNM): 3 males: 1 male: USA. MD: Montgomery Co., Potomac, 23 Jul–23 Aug 1989, Amnon Freiberg, slime flux on oak; 2 males: Maryland: Prince George's Co., Camp Springs, 1 Apr 1979, Gary F. Hevel. Other materials (HNHM, all leg. L. PAPP): 2 males: Börzsöny-hg. [Szokolya] Királyrét – tölgy kicsorgó nedvén [on outflowing sap of

an oak tree] – 1971.VI. 24.; 1 female: Szokolya, Les-völgy, tölgyfák sebein [on wounds of oak trees], 1997. VI. 22.; 3 males, 1 female: Börzsöny-hg., [Verőce] Magyarkút – 1988. IV. 8. – gyertyán és tölgy kicsorgó nedvén [on outflowing sap of hornbeam and oak trees]; 1 male: Verőce, Magyarkút, tölgyfák sebéről [on wounds of oak trees] – 1996. V. 5.; 2 females: Verőce, Magyarkút, Keskeny-bükki-p. v., 1997. IV. 27., juhar sebén [on wound of a maple] / tölgyfák sebeiről [on wounds of oak trees], 1997. VI. 10.; 11 males 11 females: Szendehely, Keskeny-bükki p.[atak] v.[ölgye] [creek valley], tölgyerdő [oak forest] – levágott juhar és gyertyáncsonkok nedvéről [on sap from cut stumps of maple and hornbeam], 1996. IV. 7.; 1 male: Diósjenő, Kemence-völgy, tölgy sebén,



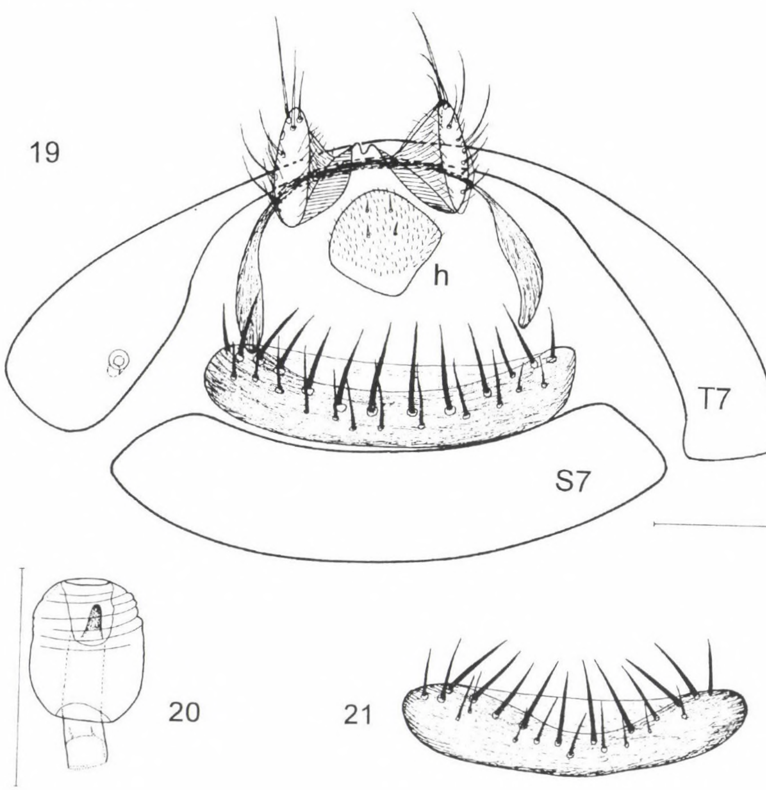
Figs 13–18. 13–14 = *Aulacigaster* spp., frons from above: 13 = *A. leucopeza* (MEIGEN, 1830); 14 = *A. neoleucopeza* MATHIS et FREIDBERG, 1994. 15–18 = male genitalia: 15–16 = *A. leucopeza* (MEIGEN, 1830): 15 = terminalia laterally, **16** = gonopod; **17** = *A. neoleucopeza* MATHIS et FREIDBERG, 1994, aedeagal complex, caudal view; **18** = *A. leucopeza* (MEIGEN, 1830), genital complex laterally. Scales: 0.1 mm For Figs 15–17 and Fig. 18, respectively

1997. VI. 10.; 1 male: Budapest, Pestszentlőrinc, Péterhalmi-erdő [reverse side] 1995. V. 1.; 1 male: ibid., tölgy sebéről [on wound of an oak tree], 1996. VI. 21.

External body characters (except for those above and in the key below) are the same as in *leucopeza*. All the above specimens were collected together with specimens of *leucopeza* and several also with *falcata*.

Epandrium with sparse setae only, particularly so dorsally. Cerci and caudal part of subepandrial sclerite very short (Fig. 12) but with some long though thin setae. Male surstylus (Fig. 7) short and emerging in an acute angle from epandrium. Its short and weak cerci visible on majority of males without genitalia preparation.

This species is new to Hungary and to the Palaearctic Region. However, I think that *A. neoleucopeza* could be a recent introduction to Europe since I did not find any specimens in old collections. The specimens in Hungary were found within a circle of c. 50 km radius. Since the ratio of the specimens of this species to *leucopeza* specimens is only 1 to 10, much more collecting is needed to better assess its distribution.



Figs 19–21. *Aulacigaster* spp., female terminalia. 19–20 = *A. leucopeza* (MEIGEN, 1830): 19 = postabdomen in ventral view, 20 = one of the three spermathecae. 21 = *A. neoleucopeza* MATHIS et FREIDBERG, 1994, sternite 8 (h: hypoproct, S7: sternite 7, T7: tergite 7). Scales: 0.1 mm

KEY TO THE PALAEARCTIC SPECIES OF AULACIGASTER MACQUART

1 (4) Orange transverse band on frons broader than half distance of lunule to fore ocellus. Humeral callus yellow or yellowish. Acrostichals tending to be biserial. Posterior half of frons (beside ocellar triangle) all shiny. Male epandrium with dense setae.

2 (3) Male surstylus long but blunt (Figs 1, 6), cerci and caudal part of subepandrial sclerite longer and broader (Fig. 1, 9). Additional small acrostichals between medial rows and dorsocentral lines. Humeral callus yellow, frons caudal to orbital bristles all shiny. Afghanistan **afghanorum** sp. n.

3 (2) Male surstylus long and sickle-shaped (Figs 2, 8), cerci and caudal part of subepandrial sclerite shorter less broad (Figs 2, 10). No acrostichals between medial rows and dorsocentral lines. Humeral callus yellowish, frons caudal to orbital bristles with narrow microtomentose orbital margins. Hungary, Croatia **falcata** sp. n.

4 (1) Orange transverse band on frons narrower or much narrower than half distance of lunule to fore ocellus. Humeral callus dark (concolorous with mesonotum). Acrostichals uniserial. Posterior half of frons (beside ocellar triangle) with a pair of shiny spot only (Figs 13–14). Male epandrium with sparse setae.

5 (6) Shiny spot lateral to ocellar triangle large (Fig. 14), i.e. its diameter distinctly broader than microtomentose orbital margin lateral to this spot. Male surstylus (Fig. 7) short and emerges in an acute angle from epandrium; male cerci short and caudal part of subepandrial sclerite (Fig. 12) short narrow and with some longer setae. Holarctic
neoleucopeza MATHIS et FREIDBERG, 1994

6 (5) Shiny spot lateral to ocellar triangle small (Fig. 13), i.e. its diameter distinctly smaller than microtomentose orbital margin lateral to this spot. Male surstylus (Figs 5, 15) long and emerges from epandrium in a far less acute angle; male cerci (Fig. 15) and caudal part of subepandrial sclerite (Fig. 11) long and broad but without long setae. Europe
leucopeza (MEIGEN, 1830)

* * *

Acknowledgement – I am grateful to Dr WAYNE N. MATHIS (Dept. of Entomology, National Museum of Natural History, Smithsonian Institution, Washington), for the loan of the paratypes of the Nearctic *Aulacigaster* species.

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A NEW SPECIES OF PERISCELIS FROM CHINA (DIPTERA: PERISCELIDIDAE)

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A new species of *Periscelis* (*P. (Myodris) chinensis* sp. n.) of the family Periscelididae is described from North China (Charbin). This is the first record of the family from the East-Palaearctic region. With five original figures.

Key words: Diptera, Periscelididae, new species, taxonomy, China

Periscelididae is a small family of acalyptrate flies. All species with known habits breed in sap runs on trees with larvae occurring in fermenting sap and adults being attracted by the odour of sap from wounds in trees (FERRAR 1987). Their larval morphology has become better known in rather recent publications (PAPP 1988, 1995).

Dr. BÉLA DARVAS (Plant Protection Institute of the Hungarian Academy of Sciences, Budapest) collected flies from the sap of poplar and other trees while on a study trip in Charbin, North China, in 1996. His collection included a specimen of Periscelididae, which is described in this paper.

The Palaearctic fauna includes only five known species (PAPP 1984, 1988) (a sixth species or subspecies from Hungary is being described). Species are recorded from northern Europe, Great Britain, Central Europe and from Afghanistan. KHOO (1989) reported an undescribed species from the Australasian and Oceanian regions, which was recently described by MATHIS (1993) as a new species and a subgenus of *Periscelis* (*P. (Notioscelis) fasciata*). There is no periscelidid species listed in the catalogue of Oriental Diptera (*Stenomicra* COQUILLETT was given as a genus of Aulacigastridae, SABROSKY 1977). Later PAPP (1988) described *P. (Periscelis) kaszabi* from Viet Nam, which is, as far as we are know, the only record of the family from the Oriental region. Thus we were delighted to discover Dr. DARVAS' specimen. Although some entomologists oppose descriptions based on single specimens, we have no doubt about its distinctiveness. In addition, this record is the first for the family from the vast East-Palaearctic areas of Asia.

Terminology used below is the same as used in MCALPINE (1987) for the Nearctic periscelidids with some minor modifications.

Periscelis (Myodris) chinensis sp. n.
(Figs 1–5)

Holotype female: CHINA, Charbin, on wounds of Populus sp. – 16 June 1996, leg. B. Darvas.

The holotype is deposited in the Diptera collection of the Department of Zoology, Hungarian Natural History Museum, Budapest. Its right wing was carefully removed and placed under a cover glass on a slide. The postabdomen from syntergosternite 7 and the spermathecae were separated, processed with sodium-hydroxide and preserved in a plastic ("ANDERSSON's") microvial in glycerine. It was preserved in alcohol for c. one year and then double-mounted on a minutia pin: most of its body parts are wrinkled.

Measurements (taken before the specimen was removed from alcohol, in mm), holotype female: body length 3.08, wing length 2.42, wing width 1.10.

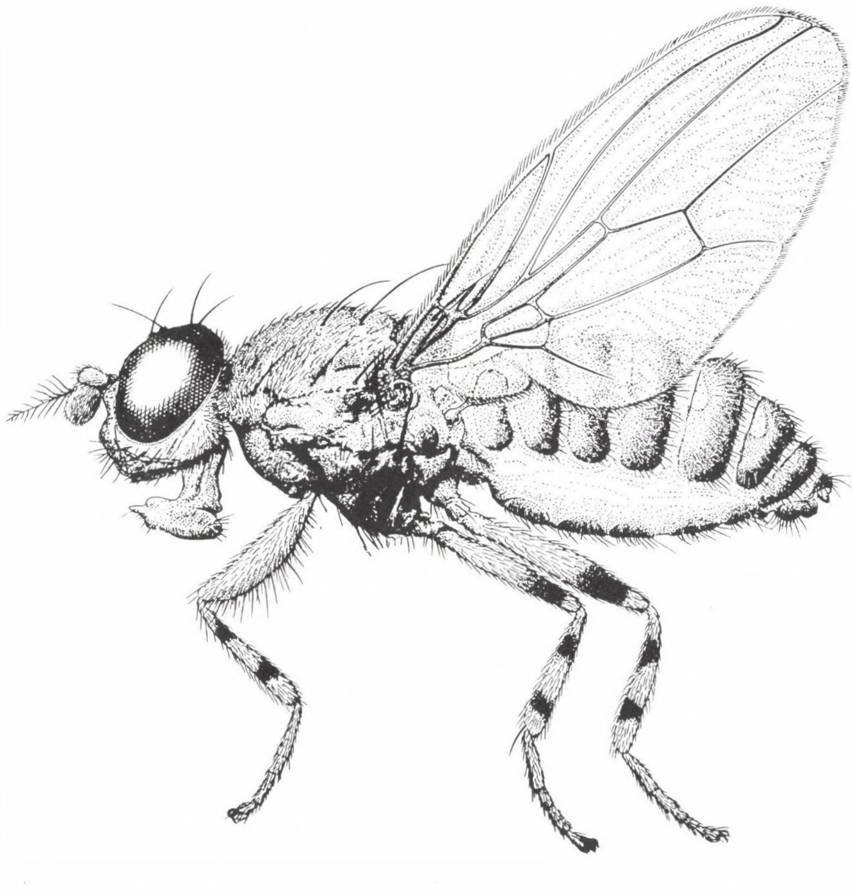
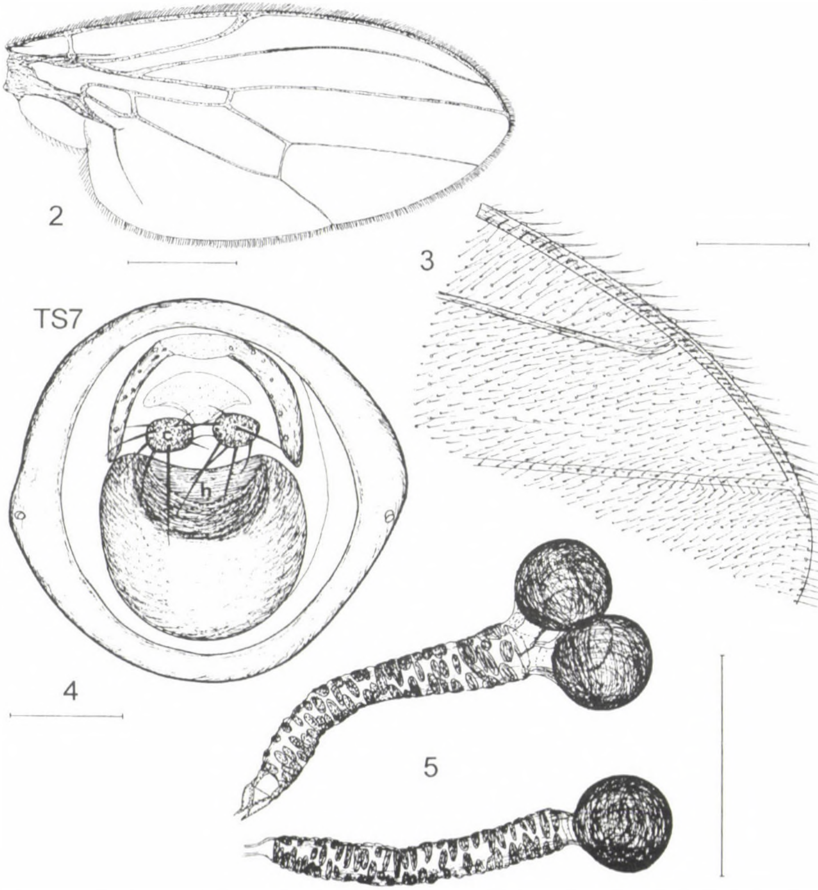


Fig. 1. *Periscelis (Myodris) chinensis* sp. n., holotype female, habitus in lateral view (drawn when in alcohol)

Frons dark grey with yellowish microtomentum, but lower orbital area dirty yellow. Face (postfrons) narrowed below antennae, with 5 pairs of bristles, 2 dorsal ones upcurved, 3 ventral pairs inclinate. Facial tubercle light brown, clypeus and palpi brown. Scape vivid yellow, similarly to whole facial plate, cheeks, genae and occiput, pedicel brown in its dorsal-apical quarter, first flagellomere yellow with some diffuse dark greyish hue. Gena with sparse but strong setae. Six long dorsal rays and 5 long ventral rays on arista (longest dorsal ray 0.17 mm, longest ventral 0.155 mm), arista also with short rays between long ones basally and behind apical fork, flagellomere long quadrate with a blunt dorsal apex and with comparatively long (0.017 mm) cilia. 1 ors, vte, vti, long postocellar pairs, ocellars emerge beside ocellar triangle.

Mesonotum subshiny, though dark brown, with greyish (not light) microtomentum. Humeral callus light yellow. Pleurae dark, only ventral part of anepisternum and of katepisternum lighter. Thoracic chaetotaxy: 1 *h*, 2 *np*, 1 *sa*, 1 *pa*, 2 strong *dc*, 2 *sc*, 3 short bristles on posterior margin of anepisternum, 2 katepisternals plus several short setae. One pair of medium long prescutellars (0.13 mm).



Figs 2–5. *Periscelis (Myodris) chinensis* sp. n., holotype female: 2 = right wing, 3 = tip of right wing with trichia, 4 = postabdomen in caudal view (hypoproct wholly covered by sternite 8; setae, other than on cerci, omitted), 5 = spermathecae (TS7: syntergosternite 7, c: cercus, h: hypoproct). Scales: 0.5 mm for Fig. 2, 0.1 mm for Figs 3–4 and 5, respectively

Fore femur brown but lighter apically and basally. Mid femur mainly yellow with a broad brown ring at distal third, hind femur mainly brown but yellow basally and apically, all tibiae with 2 broad dark brown rings subbasally and subapically. Tarsi light yellow. Fore femur with long posteroventral bristles, mid tibia with a black ventroapical seta of c. 0.10 mm.

Wings (Fig. 2) yellowish, veins ochreous, no darkening on wings. Costal vein present to vein R_{4+5}, costal sections: from humeral to R_1: 0.83, R_1 to R_{2+3} 1.17 mm, R_{2+3} to R_{4+5} 0.16 mm. Hind cross-vein (M-Cu) also present, intercross-vein section of M 0.34 mm, M-Cu 0.17 mm. Alar plane with very long microtrichia (Fig. 3): longest on costa 50–51 μm (other than strong costal fringe), on alar plane 35 μm, and appearing fumose as a consequence of colour of trichia.

Abdomen with large silvery spots on anterior lateral margin of tergites 3–6. Tergites brown, T1+2 yellowish dorsally. Tergite 7 and sternite 7 fused into a syntergosternite, which involves 7th pair of spiracles (Fig. 4). Tergite 8 very weakly sclerotized and absolutely not melanized medially, so tergite 8 appearing as if in two parts in lower magnification. Sternite 8 comparatively large (Fig. 4) with a posteromedial more melanized part. Epiproct membraneous, can be regarded as not developed since it is so weakly sclerotized and not melanized at all. Hypoproct completely hidden under sternite 8.

Female genitalia: Cerci very small with some medium long and several short setae (Fig. 4); three (2+1) spermathecae close to each other (Fig. 5) with long thick ducts, which are walled around by a mosaic of brown melanized small platelets.

Periscelis (Myodris) chinensis sp. n. is a peculiar fly. It is without question a *Periscelis* species (see key to genera in MATHIS and PAPP (1992) and fits better in the subgenus *Myodris* LIOY (cf. MATHIS 1993). However, the short setae on the dorsal posterior margin of the anepisternum show a relationship to the true *P. (Periscelis)* species. Its dark brown mesonotum and scutellum are unique among the *Myodris* species.

We agree with MATHIS's (1993) opinion that the differences between the subgenera separated hitherto are not well-contrasted, possibly except a limited number of characters in the male genitalia. The concept of *Microperiscelis* OLDENBERG, 1914 of DUDA (1934), PAPP (1973), etc., i.e. stressing the presence or absence of M-Cu cross-vein and short additional rays on arista, cannot be maintained. DUDA, for example, did not know *P. winnertzii* and *P. nigra*; knowing them, we can say that their characteristics (being true *Periscelis* species based on the male genitalia) obscures further recognition of the subgenera in *Periscelis*. Until now, maintaining the subgenus *Myodris* LIOY for three closely related but distinct species in the Holartic region (*P. annulata* (N and C Europe), *P. kabuli* (Afghanistan) and the Nearctic *P. flinti*) was reasonable. However, we cannot exclude that discovery of more Oriental and East Palaearctic species similar to *chinensis* sp. n. will make the "distance" between the species-groups even smaller and separation of the subgenera doubtful.

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Catalogue of Palaearctic Diptera

edited by Á. SOÓS, L. PAPP and P. OOSTERBROEK

Volume 1
Trichoceridae – Nymphomyiidae

The Catalogue contains the basic taxonomic, nomenclatorial and distribution data of all species occurring in the Palaearctic Region with the fundamental morphological features for the majority of the fly groups.

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FIRST DESCRIPTION OF THE IMAGINES AND PUPA OF PROPSILOCERUS JACUTICUS (ZVEREVA) (DIPTERA: CHIRONOMIDAE)

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The male and female imagines, and the pupa of *Propsilocerus jacuticus* (ZVEREVA) are described for the first time and the larva redescribed. The species is closely related to *P. taihuensis* (WEN, ZHOU *et* RONG) from Southern China. The sister species of these two species combined is *P. akamusi* (TOKUNAGA).

Key words: Chironomidae, Orthocladiinae, *Propsilocerus jacuticus*, imagines, pupa

INTRODUCTION

The genus *Propsilocerus* KIEFFER was recently revised by SÆTHER and WANG (1996). They indicated that the species described based on larva only by ZVEREVA (1950: 273) as *Syndiamesa jacutica* might be the larva of their new species *Propsilocerus sinicus*. *P. jacuticus* previously was known from just west of the Ural Mountains in the Vichegda River, Komi, Russia, as well as from Lake Päijänne in south-central Finland (ZVEREVA 1950, MERILÄINEN 1987). Recently Dr. LAURI PAASIVIRTA, Parainen, Finland, sent me several specimens of all stages and both sexes of the species. *P. jacuticus* is not conspecific with *P. sinicus* but a valid species closely related to *P. taihuensis* (WEN, ZHOU *et* RONG).

METHODS AND MORPHOLOGY

The applied mounting procedure is outlined by SÆTHER (1969: 1). Morphological nomenclature follows SÆTHER (1980) with additions and corrections given in SÆTHER (1990) and LANGTON (1994). The measurements are given as ranges followed by a mean when 4 or more measurements were made, followed by the number measured in parentheses (n).

Propsilocerus jacuticus (ZVEREVA) (Figs 1–3)

Syndiamesa jacutica ZVEREVA, 1950: 273.
Syndiamesa jacutica ZVEREVA: PANKRATOVA 1970: 73; ASHE and CRANSTON 1990: 236 (as *nomen dubium*, probably in *Tokunagayusurika*).
Tokunagayusurika jacutica (ZVEREVA): MERILÄINEN 1987: 90.
Propsilocerus jacuticus (ZVEREVA: SÆTHER and WANG 1996: 456. ? *Syndiamesa* ? *jacutica* CHERNOVSKII, 1949: 20 (*nomen nudum*)
not ? *Propsilocerus jacuticus* (ZVEREVA): SÆTHER and WANG 1996: 457 (= *P. sinicus* SÆTHER et WANG)

Material examined – FINLAND: Southern Finland, Mustalahti bay, Lake Enajärvi, 4 ♂, 9 larvae, 22.X.1996, L. PAASIVIRTA. Central Finland, Jyväskyla, Lake Tuomiojärvi, 7 ♂, parts of about 8 ♀, parts of about 7 ♀, 19.IX.1980, L. PAASIVIRTA; Jyväskyla, Lake Palokkajärvi, 8 larvae, 6 pupae, 19.IX.1980, L. PAASIVIRTA; Lake Sulkavanjo near Kuopio, 7 larvae, no date, L. PAASIVIRTA.

Diagnostic characters – The male imago can be separated from other members of the genus by the presence of a rounded superior volsella with digitiform mediolateral projection, AR of 2.2–2.6, preepisternum with 10–27 setae, and LR_1 of 0.67–0.70. The female imago is characterised by having a well-developed, about as long as wide, laterally placed secondary gonocoxite; and gonocoxite IX with a conspicuously long and narrow digitiform extension. The pupa is characterised by having 8–11 macrosetae on the anal lobe, 0.4–0.5 times as long as lobe; more than 100 taeniate setae in fringe of anal lobe; 5 taeniate setae on segment VIII; pedes spurii A present on sternites IV and V; thoracic horn without any indication of apical division and 1.2–1.5 times as long as anal macrosetae; total length 12–15 mm. The fourth instar larva has a mentum with 9–10 pairs of lateral dorsomental teeth and a concave median portion with one strong lateral pair and 4–10 minute sharply triangular teeth on ventromentum; total length 13–18 mm.

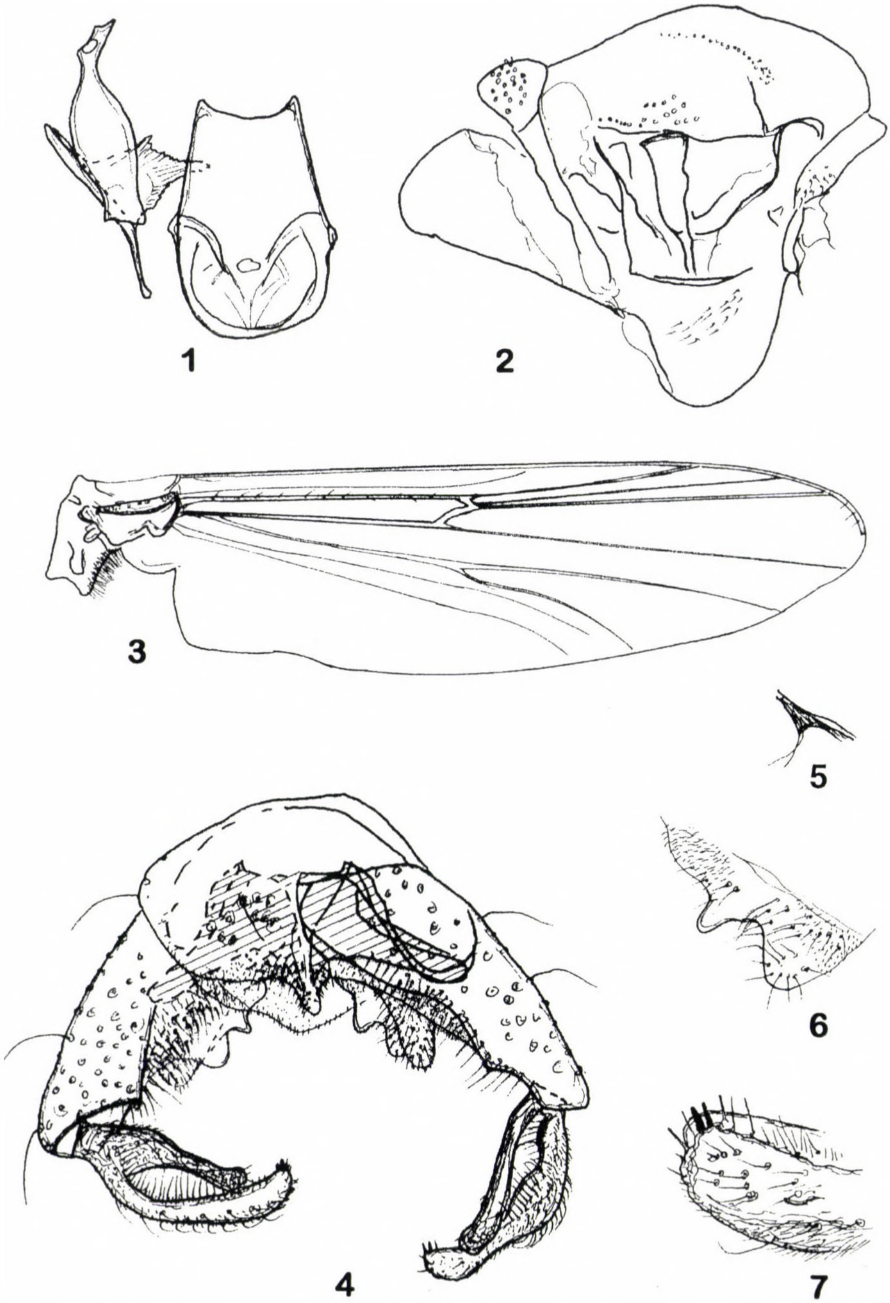
Male imago (n= 8–10 except when otherwise stated)

Total length 9.17–10.96, 9.90 mm (4). Wing length 4.86–5.75, 5.36 mm (13). Total length/ wing length 1.82–1.97, 1.90 (4). Wing length/ length of profemur 2.80–3.04, 2.93 (7).

Head (Fig. 1A). AR 2.21–2.57, 2.36 (6). Ultimate flagellomere 1103–1267, 1228 mm (6) long. Temporal setae 13–17, 15; including 4–8, 7 inner verticals; and 5–9, 8 outer verticals. Clypeus with 40–46, 43 (7) setae. Tentorium 300–341, 322 µm long; 83–101, 95 µm (6) wide. Stipes 300–319, 311 µm (6) long; 150–188, 172 µm wide. Palpomere lengths in µm: 71–90, 77; 94–150, 107; 188–225,199; 176–191, 184; 188–240, 220. Third palpomere with 4–8, 6 sensilla clavata 19–23 µm long.

Thorax (Fig. 1 B). Antepronotum with 10–28, 14 (4) setae. Dorsocentrals 17–42, 31; prealars 11–19, 13 including 6 in a single posterior row; supraalar 1; preepisternum with 10–27, 19 setae. Scutellum with 30–46, 34 setae.

Wing (Fig. 1 C). VR 1.06–1.16, 1.11. Anal lobe moderately projecting. C extension 139–169, 153 mm (12) long. Brachiolum with 2–4, 3 setae; C extension with 2–4, 3 (12); R with 13–18, 15 (11) setae; other veins bare. Squama with 47–70, 53 (12) setae.



Figs 1–7. *Propsilocerus jacuticus* (ZVEREVA), male imago: 1 = head, 2 = thorax, 3 = wing, 4 = hypopygium, 5 = median volsella, 6 = superior volsella, 7 = apex of gonostylus

Legs. Spur of front tibia 98–120, 115 µm (6) long; spurs of middle tibia 86–98, 94 µm and 75–94, 86 µm long; of hind tibia 94–120, 110 µm and 79–83, 80 µm long. Width at apex of front tibia 120–135, 128 µm; of middle tibia 120–139, 128 µm; of hind tibia 131–146, 138 µm. Middle and hind legs with 2, or occasionally 3, pseudospurs at apex of each ta_1 and ta_2, occasionally 1 pseudospurs on ta_3 of hind leg. Sensilla chaeticae 3–7, 5 (7) at 0.10–0.20, 0.13 to 0.17–0.42, 0.25 on ta_1 of middle leg; 7–15, 12 (7) at 0.10–0.16, 0.13 to 0.30–0.42, 0.38 on ta_1 of hind leg. Lengths (in µm) and proportions of legs:

	fe	ti	ta_1	ta_2
p_1	1736–1853,1792	2205–2463,2309	1501–1642,1592	903–1009,966
p_2	1501–2041,1921	2100–2323,2213	962–1079,1034	540–633,589
p_3	2088–2252,2192	2463–2733,2615	1267–1396,1337	751–835,794

	ta_3	ta_4	ta_5	LR
p_1	657–680,672	411–446,436	281–317,304	0.67–0.70,0.69
p_2	422–469,440	293–328,311	235–270,255	0.45–0.48,0.47
p_3	563–633,611	305–352,327	258–305,279	0.50–0.53,0.51

	BV	SV	BR
p_1	2.36–2.46,2.39	2.52–2.65,2.58	3.0–4.2,3.6
p_2	3.01–3.41,3.21	3.72–4.13,4.00	1.8–3.0,2.4
p_3	2.95–3.20,3.00	3.49–3.71,3.60	1.8–3.8,2.8

Hypopygium (Fig. 1 D, E). Anal point tapering to blunt apex, 83–113, 98 µm long; tergite IX with about 100–130, 113 (6) setae; laterosternite IX with 13–20, 17 (6) setae. Phallapodeme 143–158, 151 µm long; transverse sternapodeme 86–101, 93 µm (7) long. Gonocoxite 308–326, 317 µm long; inferior volsella 98–120, 112 µm long; superior volsella 75–116, 100 µm long; median volsella a 19–34, 25 µm high tubercle with 1–2 setae 53–68, 60 µm long. Gonostylus 199–206, 202 µm long; basal lobe 150–173, 162 µm long; 3–4, 3 megasetae, 19–23, 22 µm long. HR 1.52–1.62, 1.57; HV 4.52–5.32, 4.87 (4).

Female imago (n=3–4 except when otherwise stated)

Total length not measurable. Wing length 4.5–6.45, 6.16 mm. Wing length/length of profemur 3.67 (1).

Head. Antenna with 6 flagellomeres. AR 0.55–0.60. Lengths of flagellomeres (in µm): 104–113, 95–113, 104–113, 95–104, 95–104, 288–307. Temporal setae 12–13, consisting of 6–7 inner verticals, and 5–7 outer verticals. Clypeus with 46–55 (2) setae. Tentorium 300–338 µm long, 98–101 µm wide. Stipes 289–300 µm long, 146–176 µm wide. Palpomere lengths in µm: 71–83, 86–109, 165–206, 150–173, 214–219. Third palpomere with 8 sensilla clavata 19–23 µm long.

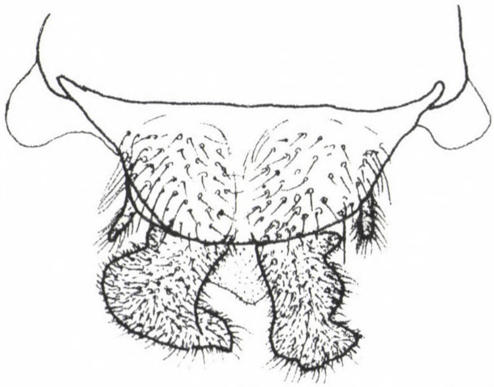
Thorax. Dorsocentrals 32 (1); prealars 19 (1), including 7 in single posterior row, supraalar 1(1). Scutellum with 37 (1) setae. Other details not measurable.

Wing. VR 1.12–1.15, 1.13. C extension 113–180, 154 µm long. Brachiolum with 3–4, 4 (5) setae; C extension with 2–8, 5 (6) non-marginal; R with 17–21, 19 (5); R_{4+5} with 1–3, 2 (5) setae; other veins bare. Squama with 70–96, 88 (4) setae.

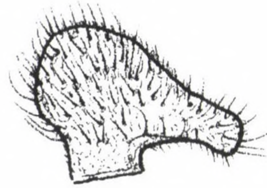
Legs (n=1). Spur of front tibia 94 m long. Width at apex of front tibia 128 m. Lengths (in m) and proportions of front leg:

fe	ti	ta_1	ta_2	ta_3	ta_4	ta_5	LR	BV	SV	BR
1689	2346	1595	927	516	411	281	0.68	2.64	2.13	1.7

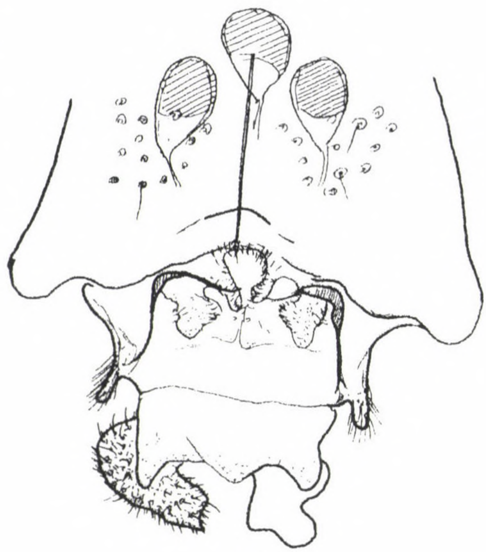
Figs 8–14. *Propsilocerus jacuticus* (ZVEREVA), female imago, genitalia: 8 = dorsal view; 9 = cercus, lateral view; 10 = ventral view; 11 = labia; 12 = dorsomesal lobe; 13 = ventrolateral lobe; 14 = apodeme lobe



8



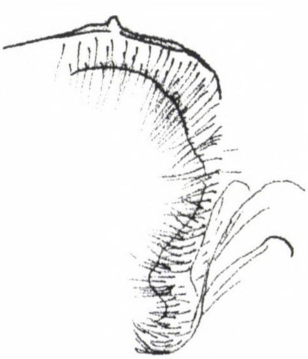
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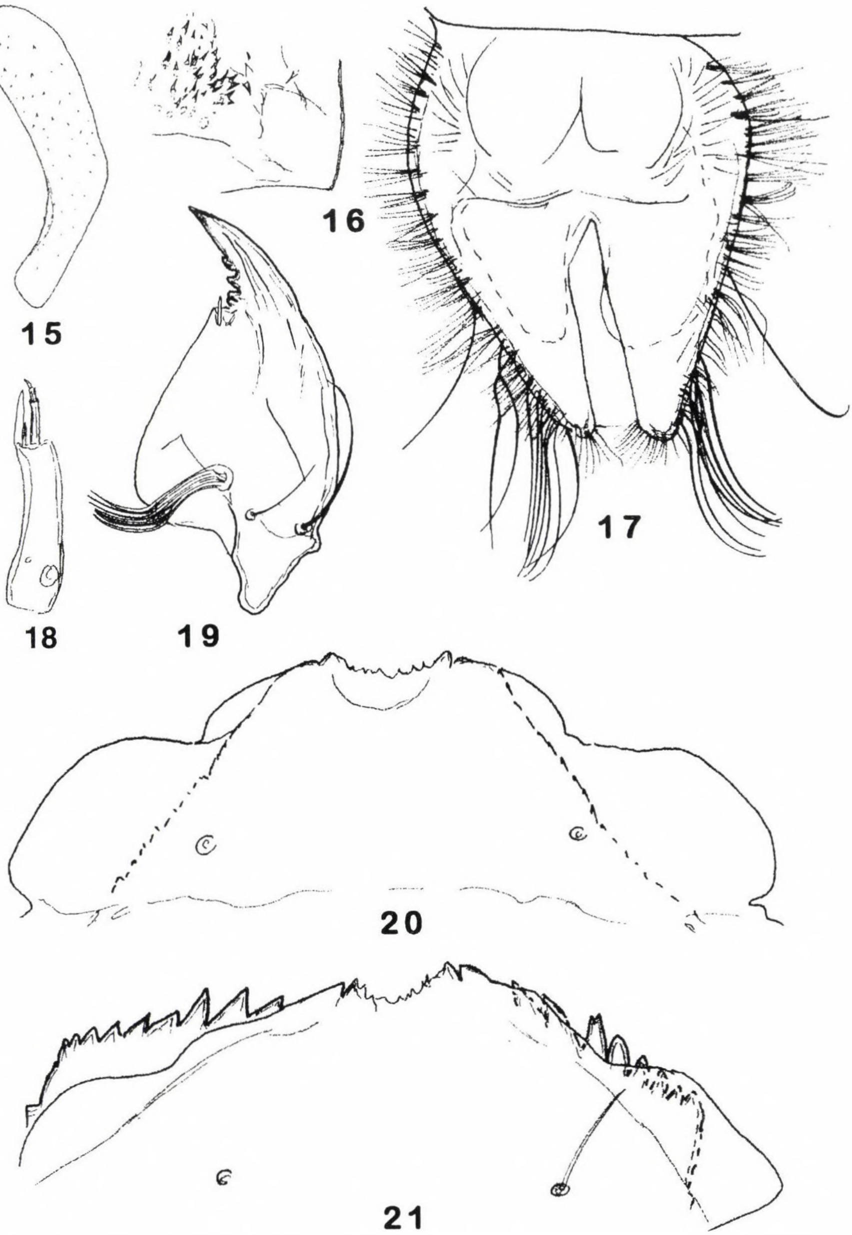
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13



14



Figs 15–21. *Propsilocerus jacuticus* (ZVEREVA), immatures: 15 = thoracic horn of pupa; 16 = pedes spurii A of sternite V; 17 = anal lobe of pupa; 18 = larval antenna; 19 = mandible; 20 = mentum, unflattened; 21 = mentum, flattened

Other legs missing.

Genitalia (Fig. 2A–G). Sternite VIII with well-developed rounded posterolateral projection (secondary gonocoxite), with about 32 (1) setae. Gonocoxite with 20–26, 22 (5) setae. Tergite IX with altogether 95–112 (2) setae. Cercus 375–425, 402 µm (6) long. Seminal capsules subequal 225–244, 231 µm long; sclerotized in anterior 131–150, 141 µm; 146–169, 163 µm wide. Labiae each with about 30 microtrichiae. Notum 394–461, 438 µm (5) long.

Pupa (n= 6–7 except when otherwise stated)

Total length of exuviae 11.9–14.5, 13.3 mm. Exuviae brownish grey with blackish brown margins of wing sheaths and apophyses.

Cephalothorax. Frontal seta absent. Thoracic horn (Fig. 3A) simple, with few and weak apical spines; 851–960, 885 µm long; 236–265, 247 µm wide; 3.25–3.84, 3.61 times as long as wide; 1.22–1.45, 1.33 times as long as macrosetae. Precorneal setae, median and lateral antepronotals, and postorbitals all 113–150, 130 µm long. Anterior dorsocentral (Dc_1) 176–218, 193 µm (4) long; second dorsocentral 150–195, 137 µm (4) long; posterior two dorsocentrals each 188–226, 222 µm (4) long. Distance between Dc_1 and Dc_2 45–86, 75 µm (4); between Dc_2 and Dc_3 270–349, 297 µm (4); between Dc_3 and Dc_4 34–101, 56 µm (4). Wing sheath with strongly sclerotized margin.

Abdomen. Tergite I bare. Shagreen otherwise as in generic description. Posterior margins of tergites III and IV or conjunctives III/IV and IV/V with minute anteriorly directed spinules. Tergite II with about 400–500 caudal hooklets in 12–15 transversal rows. Pedes spurii A present on sternite IV and V (Fig. 3 B), few to many spinules on V. Segments II–V each with 3 L setae; VI and VII each with 4 taeniate L setae; VIII with 5 taeniate L setae.

Anal lobe (Fig. 3C) 1304–1465, 1423 µm long; with 8–11, 10 macrosetae 614–728, 664 µm long; macrosetae 0.40–0.50, 0.46 times as long as anal lobe; about 130–170, 156 taeniae in fringe.

Fourth instar larva (n= 9–10 except when otherwise stated)

Total length 113.2–17.9, 15.5 mm. Head capsule length 0.76–0.80, 0.78 mm.

Head. Antenna as in Fig. 3D. Lengths of antennal segments (in µm): 113–128,118; 24–30,26; 8;8–9, 8. AR 2.50–2.91, 2.76. Basal antennal segment 41–53, 46 µm wide; blade 28–36, 32 mm long; accessory blade not measurable; ring organ 19–53, 30 mm from base; basal mark of seta 15–26 mm (3) from base; apical mark 19 mm (2) from base. Labrum and epipharyngeal area as in *P. akamusi* (SÆTHER & WANG 1996: fig. 12C). Premandible bifid 131–180, 164 µm (8) long. Mandible (Fig. 3E) 289–338, 315 µm long. Mentum as in Fig. 3F, G; 9–10, 10 lateral pairs of dorsomental teeth; apex of ventromentum concave, with outer tooth large and 4–10 small, sharply pointed, triangular median teeth. Ventromental plates large; caudolateral extension 45–71, 54 µm wide; anterior extension 23–34, 27 µm wide.

Abdomen. Posterior parapod 756–945, 820 µm (8) long, with 16–17 apical claws. Procercus 56–68, 60 µm high; 38–56, 45 µm wide; with 7 anal setae, anal setae 413–450, 418 µm (8) long. Supraanal seta 338 µm (1) long; 0.75 (1) times as long as anal setae. Anal tubules not measurable.

SYSTEMATICS

P. jacuticus has a male hypopygium very similar to that of *P. taihuensis* (WEN, ZHOU *et* RONG) from Southern China (SÆTHER & WANG 1996: fig. 13C, D). The superior volsella for instance has the same characteristic mediolateral projection which, however, is rounded instead of sharply triangular as in *P. taihuensis*. Also the female genitalia are similar between the two species with a lateral secondary gonocoxite on sternite VIII and a long digitiform extension of go-

nocoxite IX. However, the secondary gonocoxite of sternite VIII is much wider in *P. jacuticus* and the extension of gonocoxite IX much longer.

The pupa and larva both are close to those of *P. akamusi* (TOKUNAGA). The immatures of *P. taihuensis* have not been described, but undoubtedly are of the same type. The pupa differs among other characters from that of *P. akamusi* by having pedes spurii A present on sternite V, and a thoracic horn without any indication of an apical division and 1.2–1.5 times as long as anal macrosetae. The fourth instar larva differs by the concave median portion of the mentum. The differences in the premandibles mentioned in the key by SÆTHER and WANG (1996: 456) are much less pronounced than previously stated. However, the premandible appears wider in *P. jacuticus* than in *P. akamusi.*

From the above it is quite clear that *P. jacuticus* forms the sister species of *P. taihuensis*. The median projection of the superior volsella in the male and the long and narrow, digitiform extension of gonocoxite IX in the female are for instance clear and unique synapomorphies. It is equally clear that the sister species of both species combined is *P. akamusi* as shown by a number of synapomorphies in all stages.

ECOLOGY AND DISTRIBUTION

P. jacuticus previously was known from just west of the Ural Mountains in the Vichegda River, Komi, Russia, as well as from the shallow, eutrophied Lake Vatia basin of Lake Päijänne in south central Finland (ZVEREVA 1950, MERILÄINEN 1987). The larvae described herein are collected from the profundal zone of eutrophic lakes in lakes in southern and central Finland.

The zoogeographical distribution in *Propsilocerus* is quite interesting with one pair of sister species, *P. taihuensis* and *P. jacuticus*, from southern China and extreme north-eastern Europe; and another pair of sister species, *P. paradoxus* (LUNDSTRÖM) and *P. lacustris*, from north-eastern Asia and south-eastern and central Europe. The differentiation of these two pairs of sister species is almost certainly of recent Pleistocene origin.

* * *

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DESCRIPTION OF COCCIDOHYSTRIX SAMUI SP. N. (HOMOPTERA: COCCOIDEA, PSEUDOCOCCIDAE) FROM HUNGARY

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A new species, *C. samui* is described from Hungary (Budapest, Sas-hegy). An identification key is given to the Palaearctic species of the genus. Zoogeographical considerations are given for the genus. The new species represents a link between Euro–Siberian and Western-Mediterranean subregions.

Key words: Homoptera, Coccoidea, Pseudococcidae, new species, Hungary

INTRODUCTION

The eight species of the genus *Coccidohystrix* LINDINGER, 1943 have been analysed in detail by KOZÁR and PELLIZZARI SCALTRITI (1989). BEN-DOV (1994), in his world catalogue, transfered three species to the genus *Artemicoccus* BALACHOWSKY, 1953, and included one species from Madagascar in *Coccidohystrix*. In this way the genus *Coccidohystrix* contains 6 species, one from the Eurosiberian, three species from the Western-Mediterranean subregions and two species from the Ethiopian Region. In their monograph on the scale insects of Central Europe KOSZTARAB and KOZÁR (1988) mention one steppic species, *C. artemisiae* (KIRITCHENKO, 1937), known only from Ukraine (Odessa) and Kazahstan (Kalbinskoe). After long time, a new species of this genus was described from Italy by KOZÁR and PELLIZZARI SCALTRITI (1989). *C. splendens* (GOUX, 1946) (described from Marseilles, France) was found currently in Italy by MAROTTA (1994). These very fragmented data show that the Coccidohystrix genus needs further studies. The zoogeographic importance of the flora and fauna of Sas-hegy (Budapest) was treated earlier in detail by PÉNZES (1942) and PAPP (1977). BALOGH (1935) described several new species of spiders from this place. SZINETÁR and SAMU (1996) conducted a survey of the arachnofauna of the hill recently.

MATERIALS AND METHODS

This study presents the results of a sampling programme conducted in Sas-hegy Nature Reserve, Budapest (Hungary). The hill (highest peak 266 m a.s.l.) is a small natural area enclosed

by the city of Budapest. It is dominated by dolomitic grassland vegetation, with patches of human-introduced *Syringa vulgaris* and *Pinus nigra*. Specimens of the new species were collected from three different plant communities: *Pulsatillo-Festucetum rupicolae* – closed grassland, higher, many dicotyledons, on deeper soil, southern slopes; *Caricetum humilis* – semi-open, closed grassland, close to hill top; *Seslerietum sadlerianae* – endemic grassland type of the northern, north-eastern slopes. The employed collecting method was sampling of the ground vegetation by a hand-held suction sampler (D-Vac like) as described in SAMU and SÁROSPATAKI (1995), The specimens were collected on 27 February 1997 by B. KISS, 17 April 1997, and 7 August 1997 by F. SAMU and CS. SZINETÁR. In the samples 4 females and 2 larvae were found. The insects studied are deposited as microscopic slides in the collection of the Plant Protection Institute, Hungarian Academy of Sciences, Budapest.

Coccidohystrix samui sp. n.
(Fig. 1)

Material examined: Holotype, female, Hungary, Budapest (Sas-hegy), plant community: *Pulsatillo-Festucetum rupicolae*, 17 April 1997 (coll. by F. SAMU and CS. SZINETÁR) (No. in the collection: 20).

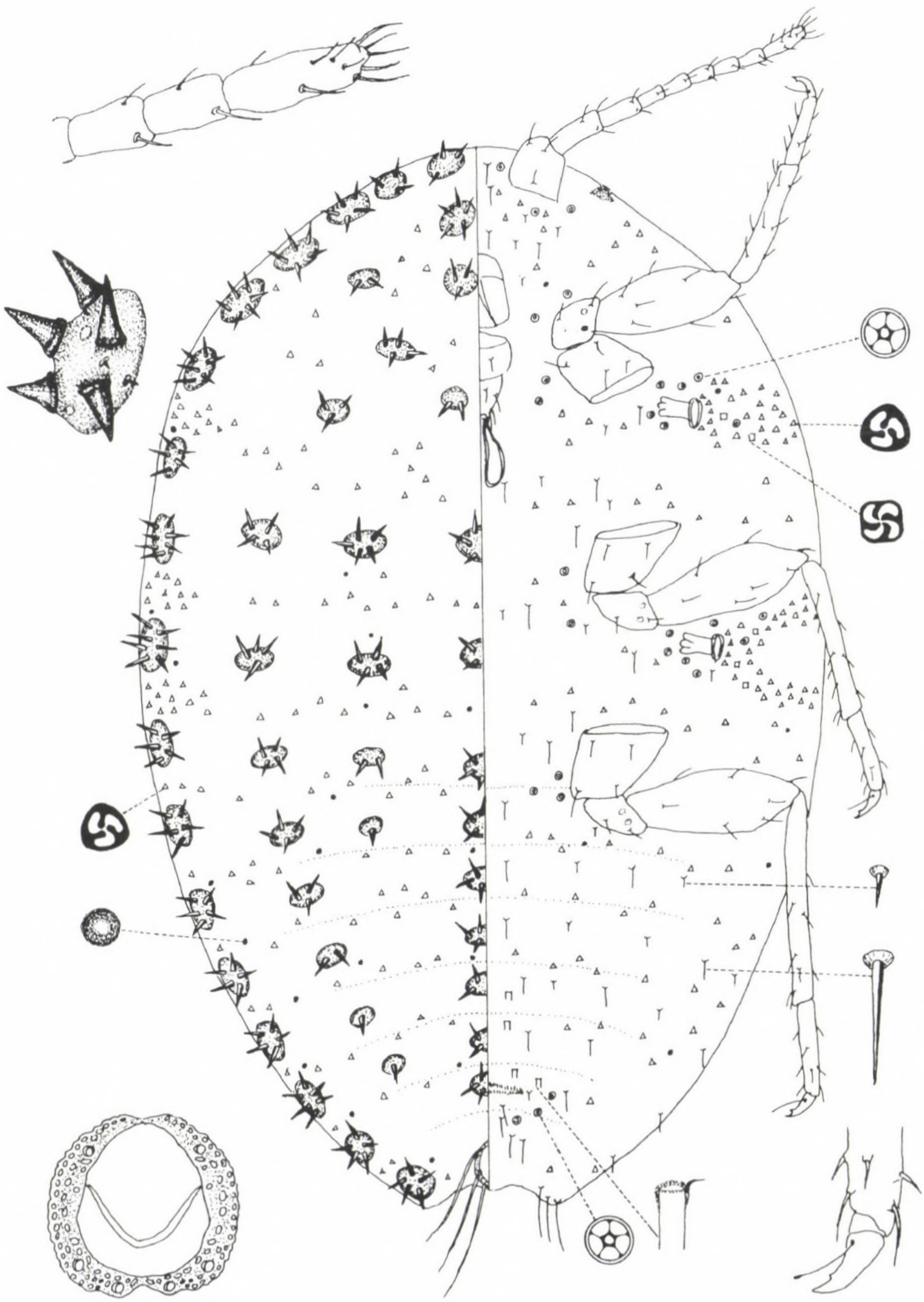
Paratypes: one female, from the same collection, but collected in a *Seslerietum sadlerianae* plant community (No. 18), one female from the same place, *Caricetum humilis* plant community, 27 February 1997 (coll. by B. KISS) (No. 17), one female from the same place, *Pulsatillo-Festucetum rupicolae* plant community, 7. August 1997 (coll. by F. SAMU and CS. SZINETÁR) (No. 48).

Description of adult female. Oval shaped, covered with white powdery wax. Mounted specimen (Fig. 1) 1.45 mm long and 0.90 mm wide. Antenna 9 segmented, size of segments: 1st – 48.0 μm long and 54.0 μm wide, 2nd – 48.0 μm and 25.2 μm, 3rd – 40.8 μm and 18.0 μm, 4th – 26.4 μm and 15.6 μm, 5th – 33.6 μm and 18.0 μm, 6th – 31.2 μm and 19.2 μm, 7th – 33.6 μm and 21.6 μm, 8th – 33.6 μm and 20.4 μm, and 9th – 60.0 μm and 21.6 μm. Apical setae of antenna slender, 14.4 μm long, near to apical setae two, 21.6 μm long, flagellate sensory seta situated.

Venter. Labium two-segmented, 94.8 μm long. Stylet loop as long as labium. Legs medium sized: coxa of anterior legs 57.6 μm, trochanter 48.0 μm, femur 153.6 μm, tibia 166.4 μm, tarsus 89.6 μm, and claw 24.0 μm, claw digitules 22.8 μm long. Coxa of middle legs 57.6 μm, trochanter 51.2 μm, femur 153.6 μm, tibia 172.8 μm, tarsus 89.6 μm, and claw 26.4 μm, and claw digitules 22.8 μm long. Coxa of posterior legs 60.8 μm, trochanter 51.2 μm, femur 160.0 μm, tibia 192.0 μm, tarsus 96.0 μm, and claw 26.4 μm, and claw digitules 25.2 μm long. Coxa without translucent pores. Claw with denticle. Thoracic spiracle opening with a band of three-four-locular and with some 5–locular pores. The posterior spiracular pore band divided towards body margin, ends of bands extending over dorsum. Diameter of anterior spiracles 22.8 μm. Circuli absent. Venter with a small number of scattered, two-sized spine-like setae, the longer 20.0 μm, and shorter 7.2 μm long. Venter of abdomen with a small number of 5–locular pores 3.6 μm in diameter and tubular ducts around vulva, 9.6 μm long. Simple discoidal pores present on venter.

Dorsum. Only three-locular pores, 2.4 μm in diameter, and discoidal pores present. Ostioles and cerarii absent. Anal ring with three rows of round pores and with 6 setae, longer than length of anal ring, longest 85.24 μm long. Anal ring 61.2 μm wide and 57.6 μm long. Dorsal conical setae very robust, 26.4 μm long, on sclerotized plates with some simple disc pores, 2.4 μm in diameter, and microseta 2.4 μm long. Each plate with 1–5 stout seta. On last 4–5 abdominal dorsal segments well-developed median and marginal plates with 3–5 seta present, and additional submarginal plates with one seta. On dorsum of thorax 5 plates situated on each segment, with 2–5 setae.

Fig. 1. *Coccidohystrix samui* sp. n., female (holotype)



The host plant of *C. samui*, is not known with certainty. Most of the members of this genus live on different *Artemisia* species. Several *Artemisia* species are present in the collecting sites, thus the possibility that this plant genus as the host of *C. samui* cannot be excluded.

Comments. Concerning the morphological details, this species is very similar to *C. splendens*, but differs in the smaller number of the dorsal plates, having 9–segmented antennae and twice longer tubular ducts.

The species is named in honour of Dr. FERENC SAMU (Hungary), acknowledging his initiative in this survey. (Common names: Sas-hegy Mealybug, Sas-hegyi pajzstetű)

A key is presented, below for all species of the genus registered by BEN-DOV (1994) in the Palaearctic Region.

KEY TO THE PALAEARCTIC SPECIES OF THE GENUS COCCIDOHYSTRIX

1 Antennae 9-segmented ... 2

– Dorsal plates in 5 rows, number of setae on plates maximum 5 ... *C. samui* sp. n.

– Dorsal plates in 6–7 rows, maximum number of setae 8 ... *C. echinatus* (BALACHOWSKY, 1936)

2 Antennae less than 9–segmented ... 3

3 Dorsal plates with 7–12 conical setae, antennae 8–segmented ... *C. artemisiae* (KIRITCHENKO, 1937)

– Dorsal plates with less than 7 conical setae ... 4

4 Antennae 8–segmented, median plates not divided ... *C. splendens* (GOUX, 1946)

– Antennae 7–segmented, median dorsal plates divided ... *C. zangherii* KOZÁR et PELLIZZARI SCALTRITI, 1989

Species of *Coccidohystrix* are found in different regions of the World, but as far as we know the centre of origin of this genus may lie in the western parts of the Mediterranean subregion of the Palaearctic Region. The similarity of the

newly described species to *C. splendens*, which is known only from France (Marseilles) and Italy (Abruzzo), presents a link between the fauna of Central-Europe and that of the Western-Mediterranean subregions. The result shows the importance of Sas-hegy (Budapest) as an important refugie of insects of Mediterranean origin, as it was mentioned earlier by PÉNZES (1942). The new data indicate that the genus needs further studies, especially in the Mediterranean countries. All known data of the genus are from xerophilous habitats.

* * *

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The oribatid species described by Berlese (Acari)

MAHUNKA, S. and L. MAHUNKA-PAPP

The authors had the opportunity for years to study the Oribatid species described by Berlese currently deposited in the Istituto Sperimentale per la Zoologia Agraria at Florence. The results of this series of studies are summarized in this volume.

The volume begins with an essay-like Introduction heavily relying on subjective opinions discussing the general questions of Oribatology. The following section lists Berlese's species placed in the modern system helping the specialists with morphological notes and many drawings; here also the condition of the specimens is discussed and lectotypes are designated.

The third, large section is the catalogue proper, wherein all the species are listed in the systematic order together with their combination and synonymic names. Here one may find all the literature data, usually missing from ordinary works, with reference to Description and Taxonomy, Distribution, with special emphasis on Catalogues whose references are partly unreliable. Where it was deemed necessary further information are added under the heading of Remarks. The volume closes with a very detailed list of literature.

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NEW SPECIES OF EUMAEINI (LYCAENIDAE) FROM SOUTHEASTERN BRAZIL I. FOUR NEW SPECIES OF DENIVIA

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Four new species of *Denivia* are described from the Gagarin Collection of Lepidoptera gathered in the early 1900s from regions of southeastern Brazil now ecologically disturbed or extirpated. New species described include *D. grava, D. secunda, D. ponsanota* and *D. striata*; these are contrasted to the more well-known and widely distributed species *D. deniva* (HEWITSON).

Key words: Lepidoptera, Lycaenidae, Eumaeini, new species, Brazil

INTRODUCTION

This is the first in a series of papers describing new species of Eumaeini ("hairstreak butterflies", Lycaenidae) from southeastern Brazil. Material examined derives principally from the Gagarin Collection of southeastern Brazilian Lepidoptera, part of which resides at the Milwaukee Public Museum (MPM), Milwaukee, Wisconsin. The collection includes samples of butterflies collected during the first five decades of the 20th Century and, consequently, contains significant material predating destruction of many of southeastern Brazil's coastal forests and various upland biomes. The major focus of the series will be "unequivocal" new species, that is, taxa so distinct from previously known relatives that species status is straightforward and not arbitrated by relative taxonomic "lumping" or "splitting". Taxonomic treatments will follow the generic framework for Eumaeini most recently reviewed by JOHNSON & KROENLEIN (1993) and BRIDGES (1994). A brief taxonomic introduction will be provided for each group. New species are described with the belief that overall diversity and species limits in various eumaeine genera cannot be fully appreciated without formal description of distinctive new entities, even if these be of extremely limited distribution or possibly extinct. Further, experience has shown that additional specimens of pre-

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viously undescribed taxa are usually located after formal descriptions appear in the literature, not before. We have been informed by Dr. K. S. BROWN, Jr. (Campinas, Brazil) that other portions of the Gagarin Collection still reside in Brazil (principally at the Universidade Federal do Paraná, Curitiba); it is thus probable that additional specimens of all species described in this series will be found in those samples.

Terminology follows that used for "elfin"-like Eumaeini by JOHNSON (1992). This includes using the abbreviations DFW, DHW and VFW, VHW for dorsal and ventral fore- and hindwings, respectively, and the term "brands" for the salient clusters of androconial scales which occur on the FW of many Eumaeini.

GENUS DENIVIA JOHNSON, 1992

JOHNSON described *Denivia* among outgroups in a monograph of Neotropical "elfin"-like Eumaeini (JOHNSON 1992). The type species was *Thecla deniva* HEWITSON [1874] (see JOHNSON 1992: 204); several species groups of *Denivia* were recognized. Three of the new species treated below belong to the "*deniva* species-group" (sensu JOHNSON 1992); two others appear to constitute a new species group. *Denivia deniva* was long considered an "isolated" taxon (sensu DRAUDT 1919), that is, one with few apparent sister taxa. JOHNSON (1992) described a sister species, *Denivia maggae*, from material most probably representing lowland humid chaco in Santiago del Estero Province, Argentina. The new species described below differ far more from *D. deniva* than did *D. maggae*.

DENIVA SPECIES-GROUP

Denivia deniva (HEWITSON), [1874]

Thecla deniva HEWITSON 1863-1878 (1874): (1) 180; (2) pl. 71, f. 535, 536.
Denivia deniva: JOHNSON 1992: 203, 204. Figs 1, 3, 9.

Description. Wings. A large species (Fig. 1, FW 16.0-18.0 mm) with HW shape greatly distended toward the anal margin by a distinct "anal" tail (sensu JOHNSON 1992: 5; fig. 1) an elongate lobe at the HW anal angle formed by fusion of the vein CuA_2 tail and the anal lobe. Male dorsal colour dull iridescent blue, often of lavender hue, female duller; males with FW brands dull diffuse fuscous, only moderately outstanding over the iridescent ground, elliptical in shape and occurring in the distal 33-40% of the discal cell (Fig. 3). Venter with variegated ground colour of heavily contrasted and "grizzled" [i.e. finely peppered with scales of contrasting colour] beige, brown, and black. The contrasting colours form, on FW: light beige postmedial and submarginal bands over darker brown ground; and, on HW: patterns of light beige patches (surrounded by grizzled dark brown and black) occurring as (i) three postbasal patches (costal, discal, and anal) and (ii) a medial

band of disjunct oblongate patches. The bandlike patches are more or less pronounced depending on the extent of the darker grizzled distal grounds characterizing individual pecimens.

Genitalia (Fig. 9). Brush organs (ELIOT 1973: 384, footnote) are lacking. The male genital valvae has bilobes and caudal extensions both gradually tapered and of about equal length, the former is only slightly more robust than the latter.

Female genitalia show a robust, tubular, configuration with respective posterior and anterior elements joined by a narrower neck; terminal elements exhibit caudally directed prongs.

The holotype deposited in The Natural History Museum, London, examined by JOHNSON (1992). Type locality: "Brazil".

Distribution. Specimens are known from throughout lowland tropical rain forest of the Amazon Basin and southward into southeastern Brazil and immediately adjacent Argentina and Paraguay.

Remarks. The *deniva* subgroup mentioned above is now seen to contain *D. deniva, D. maggae*, and the new species described below. Male genitalia of this subgroup have an elongate saccus and diminutive valval bases compared to the new subgroup described hereafter. Male genitalia of this latter subgroup are in some ways reminiscent of the "*laudonia* species-group" of *Denivia*. In the female genitalia of *D. deniva* the neck is nearly transparent, the posterior element short but greatly fluted to a pronounced antrum, and the terminal prongs robust (see JOHNSON 1992, figs 236–237). Females of the new subgroup show less extreme division of the anterior and posterior ductal elements and, in known species, lack terminal prongs.

Denivia grava sp. n.
(Figs 2, 3, 10)

Diagnosis. Wings. Large (FW 18.0 mm), as *D. deniva*, but differing markedly in dorsal and ventral structures and pattern as follows. HW with anal lobe and tail at vein terminus CuA_2 more discrete. Dorsal colour bright deep azure blue, male with FW brand appearing far larger than on *D. deniva* (encompassing the distal 50% of the discal cell and the surrounding radial veins) and coloured basally velvetine black, distally glossy fuscous. Venter most like *D. deniva* but differing by dark brown and black grizzling being so extensive that all beige areas are minimized and, particularly, this minimizing causes the medial band to appear more as a set of meandering black lines overlaying barely visible beige.

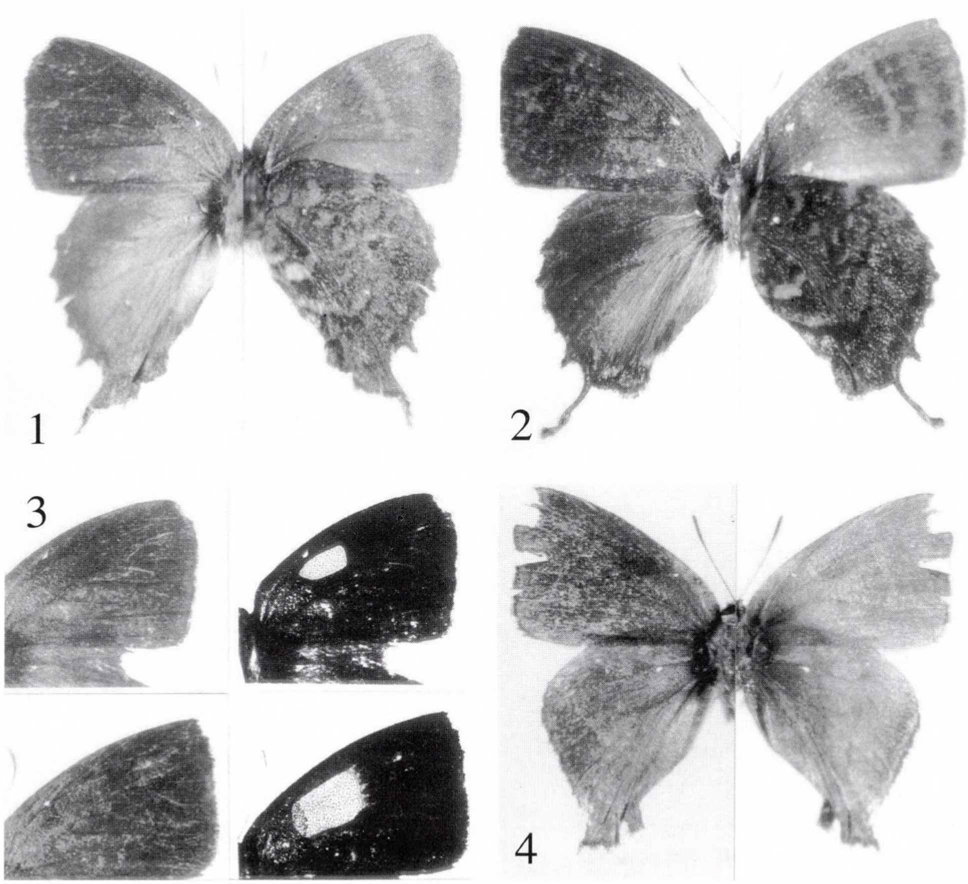
Genitalia. The saccus has the elongate, club-ended, shape typical of the *deniva* subgroup but it is steeper than that in most specimens of *D. deniva*.

Description. Male. Dorsal ground deep iridescent azure blue bordered by narrow (1 mm) black margins on both wings, those on HW crennate along outer margin. FW brand large, encompassing distal 50% of discal cell plus some 1 mm of surrounding radial veins;brand coloured basally velvetine black, distally glossy fuscous; HW with short tail at terminus of vein CuA_1, very

elongate tail at terminus of vein CuA_2, latter discrete from the blackened HW anal lobe. Venter with variegated ground of contrasting grizzled beige, brown, and black, these contrasting colours forming, on FW, black bands medial, postmedial and submarginal the intervening area, of light ground between medial and postmedial areas, appearing as a contrasting light beige band. HW strewn with profuse dark brown and black grizzling, obscuring beige ground; postbasal area showing barely visible small patches of beige at costa, discal cell, and along the anal margin; medial rea with a discontinuous but bandlike element comprised of reticulate black lines overlaying obscured beige ground; distal area with black dashes in each cell along the margin. FW length: 18.0 mm (holotype).

Female unknown.

Male genitalia (Fig. 10). The male lacks brush organs. The valvae have sharply shouldered bilobes, the lateral extension of the shoulder nearly equalling the length of the caudal extensions. This produces a ventral valve shape appearing like an inverted arrowhead with the terminal expanse of the bilobes about double that of the caudal extensions. The club-ended saccuss is elongate;



Figs 1-4. Adults of certain *Denivia* species: 1 = male, *D. deniva*, BRAZIL, Guapy, Estado do Rio, leg. Gagarin, MPM; 2 = holotype male, *D. grava*; 3 = close-ups of FW brands (glossy photo left, expanse of brand by stipples at right) above, *D. deniva*, below, *D. grava* [basal black margin of brand stippled darker]; 4 = holotype male, *D. secunda*

the aedeagus is robust and elongate with caecum and shaft both bowed, former comprising about 30% of aedeagus length.

Holotype, male (Figs 2, 3), "BRAZIL, Umuarama, Est. de S. Paulo, 1800 m, 3-15 do 2-1937, leg. Gagarin", ex. J. R. NEIDHOEFER Collection acquired from P. GAGARIN, Milwaukee Public Museum.

Remarks. Habitat, apparent endemism, and sympatric sister species. BROWN (in litt. to JOHNSON) notes concerning the type locality: "hotel to the south of Campos de Jordao in the high Serra de Mantiqueira at 1600–2200 m., 22°45'–45°35'; temperate forest and open fields, heavy frosts all winter; Gagarin spent summers here and found fantastic Patagonian fauna". All the new *Denivia* species described herein derive from this locality and, in several papers, JOHNSON (in various publications not elaborated here) has described other unique taxa from Umuarama. Outstanding differences between the *Denivia* taxa described herein involve not only wing and tail structure, along with colour and pattern, but also the genitalia and internal and external secondary sexual characters. Considering these, it must be concluded that the habitats collected by Gagarin at Umuarama, supported not only some sister species of more well-known tropical taxa (like *D. grava*, a sister of *D. deniva*) but also, several sympatric sister taxa as well (see entries below for *D. ponsanota* and *D. striata*).

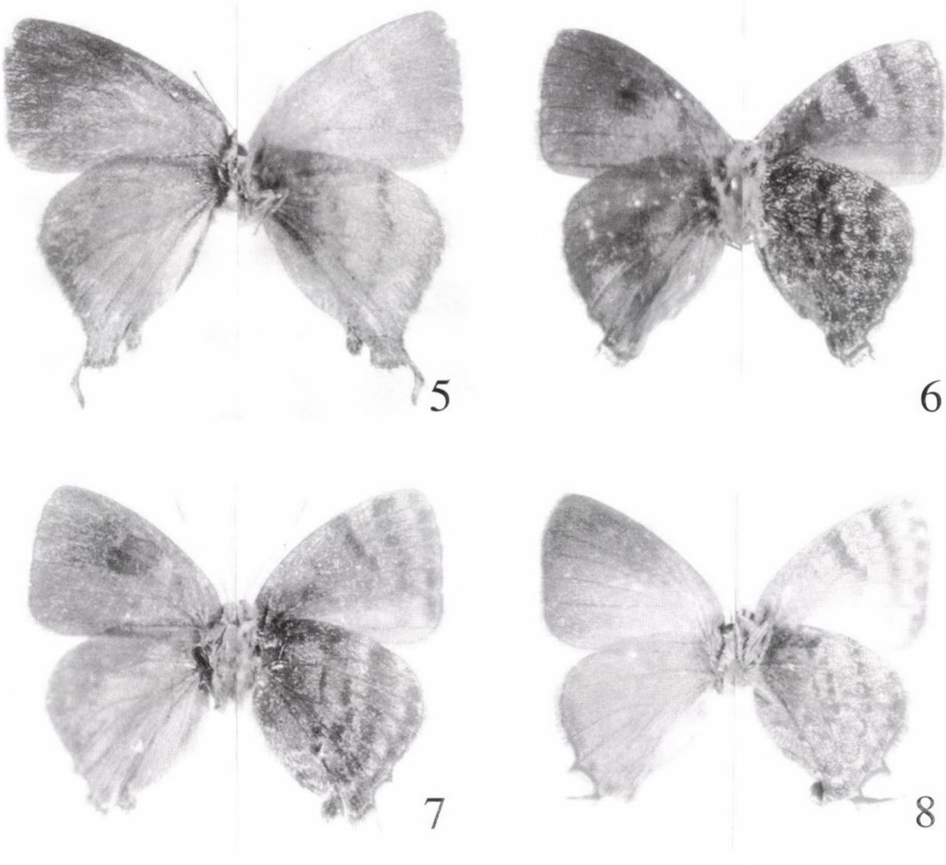
Etymology – The Latin name means "ponderous" or "weighty", referring to the various "heavy" markings of this species (large DFW brands, thickened tails and blackened ventral patches) externally making this species so distinctive from *D. deniva*.

Denivia secunda sp. n.
(Figs 4, 5, 11)

Diagnosis. Wings. Moderate in size (FW 14.0 mm), HW showing prominent and elongate anal tail with adjacent anal lobe less prominent than in *D. deniva*. Dorsal colour dusty dark lavender blue indiscernably fading into fuscous borders, male with FW brand small and elliptic, smaller than in *D. deniva* (encompassing the distal 30% of the discal cell) and dusted blackish. Venter differing from both *D. deniva* and *D. grava* by minimal suffusion to the ground colour, rather, with wings mostly concolorous beige crossed by discrete but somewhat suffusive brown bands, one across FW postmedial area (dusted with lighter beige within) and two across the postbasal and medial areas of the HW, fresher specimens with some adjacent brown suffusion along the anal margin. Care must be taken not to confuse this species with *Radissima chaluma* (SCHAUS, 1902) and *R. curitabaensis* JOHNSON, 1992 both tropical biome species occurring in southeastern Brazil. Particularly the simplified figure of *R. catadupa* (HEWITSON, [1869]) (an Ecuadorian sister of these species) by DRAUDT (1919, pl. 153e) might cause

confusion because it shows two simple bands on the VHW. However, *Radissima* species have very different genitalic features compared to *Denivia* (JOHNSON 1992, figs 90-95) and both *R. chaluma* and *R. curitabaensis* have venters far lusher than *D. secunda* (with suffusions of gray, white, bluish etc., see Remarks and DRAUDT 1919: 757–758).

Genitalia. The vinculum of the male is narrow and of uneven contour with brush organs which are lacking in *deniva* and *secunda* along the dorsum. The female prominently exhibits the bipartite ductus bursae typifying the genus but there is not a strong antrum at the posterior as in *deniva* and, in the terminal lamellae, there are two elongate prongs flanking a deep central fissure, not flanking in *deniva*.



Figs 5-8. Adults of certain *Denivia* species: 5 = allotype female, *D. secunda*; 6 = holotype male, *D. ponsanota*; 7 = holotype male, *D. striata*; 8 = Allotype female, *D. striata*

Description. Male: Dorsal ground dusty dark lavender blue blending distally with wide (5-6 mm) fuscous borders on both wings, FW brand small and elliptic, encompassing distal 30% of discal cell and suffused slightly blackish; HW with anal tail elongate and narrow, with adjacent anal lobe moderately prominent. Venter with generally concolorous beige ground broken only by discrete darker brown bands (somewhat suffusive within) one across the FW postmedial area (suffused lighter beige within), two others, postbasal and medial, across the hindwing (the medial one slightly wider and more suffusive and both converging just anterior the anal lobe); fresher specimens show brown suffusion along the anal margin and there is a slight (1 mm) brown marginal line. FW length: 14.0 mm (holotype).

Female. Similar to male, differing only in lack of FW brands and showing a duller, lavender-gray, dorsal ground. FW length: 14.0 mm (allotype and paratypes).

Male genitalia (Fig. 11). Brush organs occur along the vincular dorsum. The vinculum is narrow and of uneven contour, the saccus elongate and tapered without a club-end; the valvae with robust shouldered bilobes but the distal margin of the shoulder is rounded and the caudal extensions are short (length about same as maximal width of bilobes) and terminate in two short, successively sloping, steps. The aedeagus has the caecum in the anterior two-fifths displaced some 60 out of the plane of the aedeagal shaft.

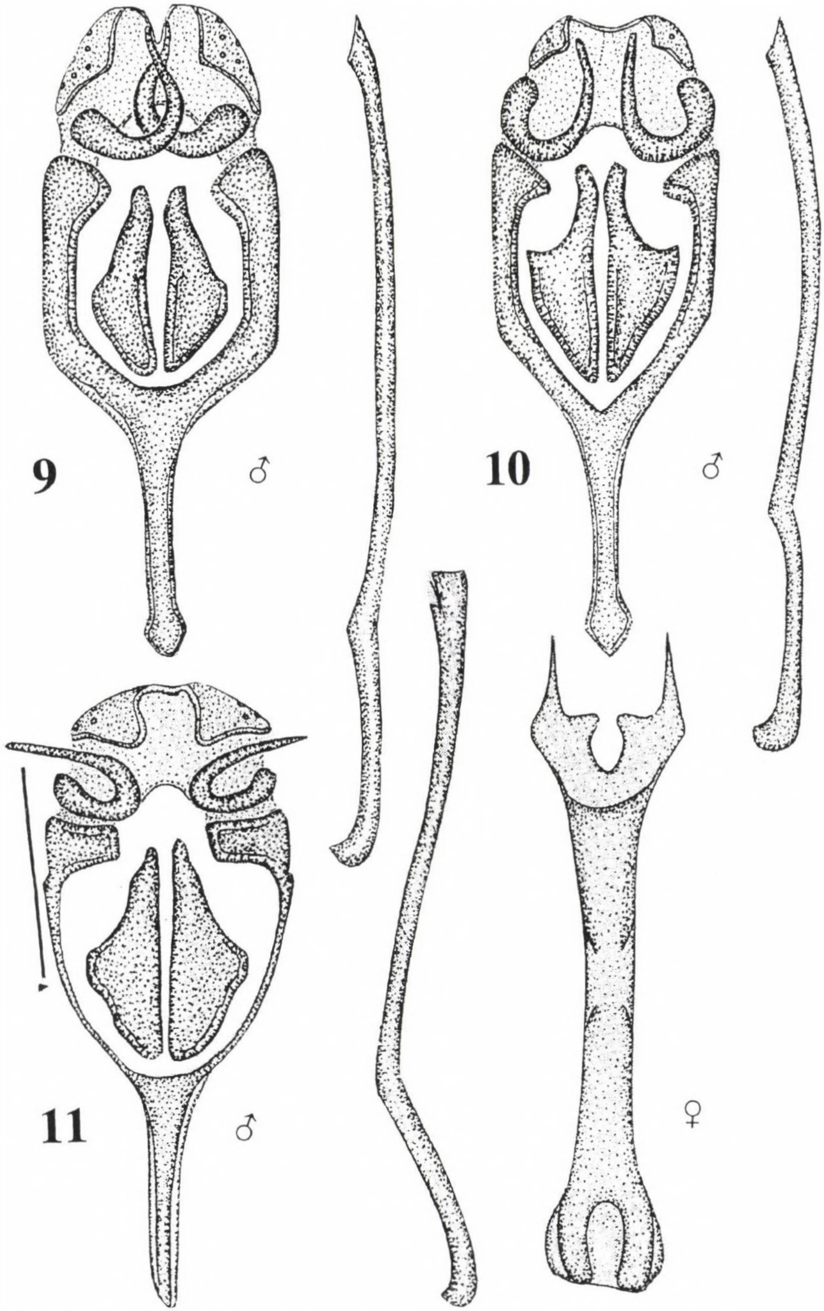
Female genitalia (Fig. 11). The ductus bursae strongly shows the bipartite elements typifying the genus but, contrasting *D. deniva* (JOHNSON 1992, fig. 236) no wide antrum occurs at the posterior; instead the ductus is terminally fluted to two lamellal lobes each tips with and elongate prong and separated by a deep central fissure.

Holotype, male (Fig. 4), allotype female (Fig. 5), "BRAZIL, Umuarama, Est. de S. Paulo, 1800 m., 3-15 do 2-1937, leg. Gagarin", ex. J. R. NEIDHOEFER Collection acquired from P. GAGARIN, deposited in Milwaukee Public Museum.

Paratypes. Six males, same data as holotype, except dated "8-15 do 3-1937" (three), "3-15 do 2-1937" (three); three females, same data as allotype, except dated "8-15do 4-1937" (two), "3-15 do 2-1937" (two). All deposited in MPM except one male "8-15 do 3-1937" in AMNH and one female "8-15 do 4-1937" in AME.

Remarks. Habitat – Remarks under *D. grava* pertain. *Denivia secunda* looks somewhat larger than its FW length (known specimens 14.0 mm) suggests; this results from the elongate anal tail (giving the species an up to 25.0 mm FW tip to anal tail tip length). As noted in the diagnosis, this species should not be confused with certain *Radissima* species. We stress this because our first view of the taxon, prior to dissection and because of the parallel bands on the VHW, was that it was a species of *Radissima*. Given the genitalia, however, the VHW pattern appears to only represent a reduction of the overall suffusive patterns common to *Denivia*. This is particularly apparent in fresher specimens (like the paratype female above) which show brown suffusion across the anal area inside the postmedial band.

Etymology. The Latin name means "second of a series of rows" and refers to the two wide and suffusive brown bands on the ventral HW which typify this species.



Figs. 9-11. Genitalia of certain *Denivia* species: 9 = male genitalia, *D. deniva*, data as in Fig. 1; 10 = Male genitalia, *D. grava*, holotype; 11 = male genitalia, *D. secunda*, holotype, left, female genitalia, allotype, right. Black line and at left of vinculum indicate, respectively, extent and location of abuttment of brush organs

PONSANOTA SUBGROUP

The following two species, although assignable to the "*deniva* species-group" differ markedly from other members of the *deniva* group by their lack of a caudally distended HW (i.e. the "anal tail"). The different HW shape, along with other characters of wing pattern and morphology, suggest a distinct subgroup within the "*deniva* species-group" containing the two sister species described below. Although these two new species differ notably in the hue of their dorsal colour, FW brand shape, and ventral pattern detail, the most remarkable differences occur in the genitalia. For brevity, in describing this new species pair we first provide a detailed diagnosis of one species and then, based thereon, a more abbreviated diagnosis for the second.

Denivia ponsanota sp. n.
(Figs 6, 12)

Diagnosis. Wings. Moderate in size (FW 14.5 mm) and, like the species *D. striata* described hereafter, without an anal tail; instead, HW with a small anal lobe completely separate from hairlike tails terminating HW veins CuA_1 and CuA_2. Contrasting *D. striata, D. ponsanota* shows crisp cobalt blue dorsal colour (in angled light with a greenish tint) and wide (2 mm), well-defined black borders, blackened wing veins, and large (4×4 mm) nearly square black FW brands (*D. striata* is lighter blue with lavender tint, has obscure fuscous borders, veins iridescent, and ovate [4×4 mm] black FW brands). Ventrally, *D. ponsanota* and *D. striata* are both grizzled brown and black over beige, but show marked differences in expression of ventral bands. On the FW, *D. ponsanota* has full postbasal, medial, and postmedial blackish bands (*D. striata* only medial and postmedial). On the HW, *D. ponsanota* has grizzled suffusions almost obscuring any appearance of prominent stripes, while *D. striata* shows three crisp grizzled stripes medial, postmedial, and marginal. At the HW anal lobe *D. ponsanota* is almost completely black except for a thin yellow-white line edging the anal margin (resembling the anal lobe that typifies the Andean elfin genus *Pons* [JOHNSON 1992]); *D. striata* has a reduced "hairstreak-like" anal lobe located along the inside of the anal margin and coloured dark brown with a yellow base. Genitalia. The male genital vinculum is narrow but of generally even contour with saccus short and parabolic compared to the members of *deniva* subgroup.

Description. Male. Dorsal ground crisp iridescent cobalt blue (sheening to greenish when turned in strong light) with vivid (2 mm) black borders (wider along FW apex), wing veins prominently blackened, outer margins entire; HW with rounded anal lobe (not distended "anal tail") and with a hairlike tail at terminus of vein CuA_2 (moderate in length and basally thickened on known

specimen); FW with large (4×4 mm) square-shaped black brands. Venter with variegated ground of contrasting and grizzled dark beige, brown, and black (sometimes flecked with gray), the darker areas forming, on FW, three black bands (postbasal, medial, and postmedial broken by intervening lighter brown) and, on HW, nearly completely dark coloration obscuring any recognizable bands. Instead, barely visible over the dark ground are black intercellular marks across the postmedial area and, across the media area, heavily powderings of gray with intervening brown. Distally, the wing is more concolorous around the anal lobe. FW length: 14.5 mm (holotype).

Female unknown.

Male genitalia (Fig. 12). Brush organs occur along the vincular dorsum. The vinculum is narrow but of generally even contour with a short and parabolic saccus; the valvae have greatly rounded shoulders at the bilobes which contrast short and narrow caudal extensions; the labides and falces are diminutive; the aedeagus exceeds the rest of the genitalia by about the caecum length, latter displaced some 45 from the plane of the aedeagal shaft.

Holotype, male (Fig. 6), "BRAZIL, Umuarama, Est. de S. Paulo, 1800 m., 3-15 do 2-1937, leg. Gagarin", ex. J. R. NEIDHOEFER Collection acquired from P. GAGARIN, Milwaukee Public Museum.

Remarks. Habitat – Remarks under the *D. grava* pertain.

Etymology. The name combines a Latin suffix meaning "marked like" to the name of a Eumaeini genus, *Pons*, and refers to superficial similarity between the short-tailed members of that genus and this cryptically marked new species of *Denivia*.

Denivia striata sp. n.
(Figs 7, 8, 13)

Diagnosis. Wings. Moderate in size (FW 14.0-15.0 mm) and differing from *D. ponsanota* as detailed in the previous entry and summarized here as follows. Male dorsum lavender-hued blue dorsum with obscure narrow fuscous borders, and, on FW, large [4×4 mm] ovate black brands. Venter with greatly contrasted light beige and dark brown grizzled grounds formed into prominent bands medial and postmedial on FW; medial, postmedial, and submarginal on HW. Female similar to male on venter, dorsally coloured more dull lavender-gray.

Genitalia. Male genitalia greatly contrasting *D. ponsanota* lacking brush organs and with vinculum widely parabolic and showing a broad saccus.

Description. Male. Dorsal ground dull iridescent blue (with distinctive lavender hue) with dull and narrow (2 mm) fuscous borders (wider along FW apex) and wing veins generally concolorous with iridescent ground, outer margins entire; HW with diminutive anal lobe (not a distended "anal tail") and two hairlike tails, one of moderate length at terminus of vein CuA_1, another more elongate at terminus of vein CuA_2; FW with large (4×4 mm) ovate blackened brands. Venter with greatly contrasted dark brown and light beige ground colours forming, on FW, two dark brown bands, medial and postmedial, with the intervening area coloured lighter beige; on HW, crisply defined dark grizzled brown stripes, medial, postmedial and marginal. Distally, the HW submargin shows bright yellow-white intercellular spots across the entire wing to the anal lobe and the anal lobe is small with a yellow-based dark brown spot just inside the anal angle. FW length: 14.0 mm (holotype).

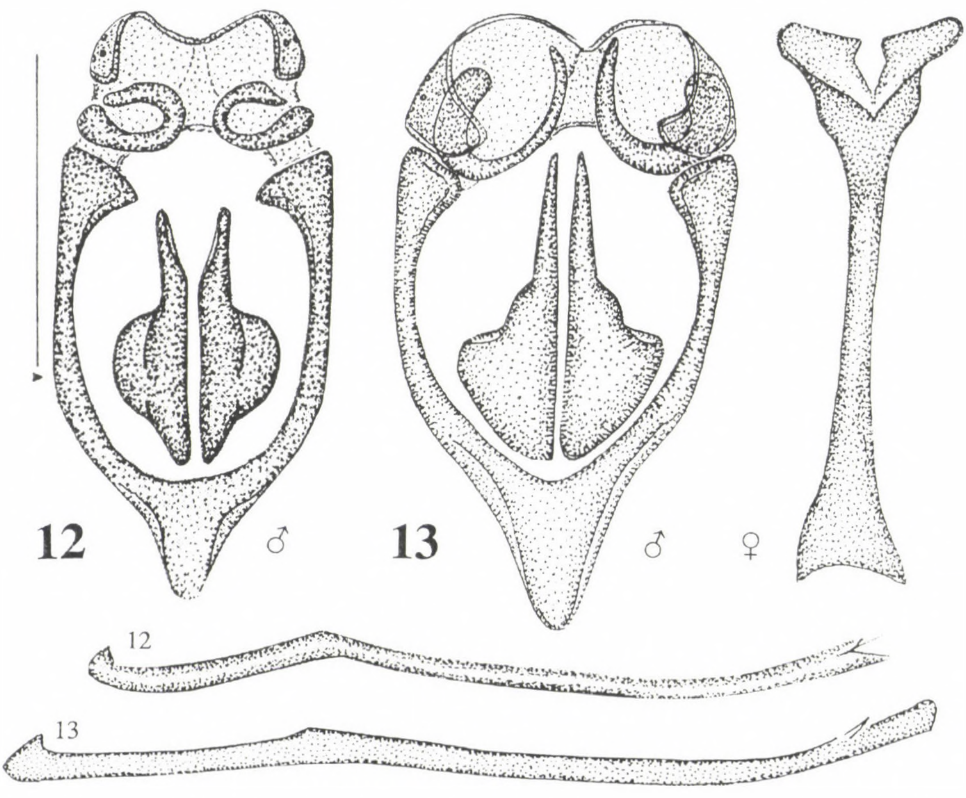
Female. Extremely similar to male, differing only in the lack of FW brands, and showing a duller lavender-gray dorsal ground colour. FW length: 15.0 mm (allotype).

Male genitalia (Fig. 13). No brush organs along dorsum of vinculum. Vinculum widely parabolic with wide and parabolic saccus; valvae with bilobes greatly shouldered and with a second small shoulder at the juncture to the caudal extensions, caudal extensions elongate and tapered; labides very enlarged, somewhat ventrally overlapping the widely arched falces; aedeagus elongate and robust, length exceeding rest of genitalia by about caecum length, caecum and shaft both bowed.

Female genitalia (Fig. 13). Ductus bursae an elongate robust tube flared both at posterior and anterior, posterior flaring to widely expanded, paired, elliptic lamellae separated by a wide central fissure; anterior flared to a swollen cervix bursae not quite as distally expansive as the posterior structures.

Holotype, male (Fig. 7): "BRAZIL, Umuarama, Est. de S. Paulo, 1800 m, 3-15 do 2-1937, leg. Gagarin", ex. J. R. NEIDHOEFER Collection acquired from P. GAGARIN, Milwaukee Public Museum; allotype female (Fig. 8), "BRAZIL, Umuarama, Est. de S. Paulo, 1800 m., 8-15 do 3-1937, leg. Gagarin", ex. J. R. NEIDHOEFER Collection acquired from P. GAGARIN, Milwaukee Public Museum.

There is also a female (MPM) which we do not make a paratype because it has two labels, each "Independencia, 900 m., Petropolis – E. do Rio, 12-10 1939, Gagarin (12 Oct.)", these dual labels and the different location from the types suggesting labels may have been previously misassociated.



Figs 12-13. 12 = Male genitalia, *D. ponsanota*, holotype; 13 = Male genitalia, *D. striata*, holotype, left, female genitalia, allotype, right. Black line and at left of vinculum indicate, respectively, extent and location of abuttment of brush organs

Remarks. Habitat – Remarks under *D. grava* pertain. Morphology – The wide saccus and wide and shouldered valval base in male genitalia of this species are reminiscent of some features typifying the "*laudonia* species-group" of *Denivia*.

Etymology. The Latin name refers to the striped appearance of the venter.

DISCUSSION

From placement of specimens at the MPM, early workers on Gagarin material (perhaps in Brazil) appear to have considered each of *D. deniva* and *D. grava*, and *D. ponsanota* and *D. striata*, the same species (although none was identified). The great differences in these species' morphologies illustrates a still persistent problem concerning the identification of Eumaeini (the Neotropical "*Thecla*" of old common usage [see DRAUDT 1919]). Even today, workers often cluster specimens by vague and general similarities, often picking one or two arbitrary external characters as a guide (e.g., with the species herein, most likely wing shape in *D. deniva / D. grava*, general ventral similarity in *D. ponsanota / D. striata*). Other differences, as elaborated herein for wing pattern and external secondary sexual organs, are usually overlooked. Our results show that morphology in these entities differs in nearly every element of the male genitalia as well as its associated secondary sexual structures. The known females also differ (for *D. deniva* see JOHNSON 1992). This circumstance strongly supports our view that a major effort to describe various unique Eumaeini from the Gagarin Collection is indispensable to a fuller understanding of the original butterfly fauna of southeastern Brazil.

* * *

Acknowledgements – We thank Dr. ALLEN M. YOUNG and Ms. SUSAN BORKIN (MPM) for facilitating our making a synoptic study collection of the MPM GAGARIN Theclinae. We also thank Dr. KEITH S. BROWN Jr. (Campinas, Brazil) for comments on the various label data of GAGARIN specimens.

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DATA TO THE CONIOPTERYGID FAUNA OF YEMEN, WITH DESCRIPTION OF TWELVE NEW SPECIES (NEUROPTERA: CONIOPTERYGIDAE)

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A large coniopterygid material collected mostly by A. VAN HARTEN in Yemen contained about 400 males and a few positively identified females of 22 species. Twelve of them, *Cryptoscenea hoelzeli* sp. n., *C. ohmi* sp. n., *Helicoconis beata* sp. n., *Nimboa sumarana* sp. n., *Coniopteryx (Xeroconiopteryx) appendiculata* sp. n., *C. (X.) collaris* sp. n., *C. (X.) makarkini* sp. n., *C. (X.) sanana* sp. n., *Coniopteryx (Coniopteryx) curvicaudata* sp. n., *C. (C.) vanharteni* sp. n., *Conwentzia sabae* sp. n. and *Semidalis tenuipennis* sp. n. are described as new, while *Coniopteryyx (X.) ketiae* MONSERRAT for the first time is reported from the Arabian Peninsula. Occurrence of the clasping fore leg in *S. tenuipennis* also is worth of mentioning.

Key words: Coniopterygidae, new species, Yemen, clasping fore leg

INTRODUCTION

Since MEINANDER's first monograph on Coniopterygidae (MEINANDER 1972*a*); many new species and interesting data have been published on the coniopterygid fauna of the Arabian Peninsula (MEINANDER 1977, 1979, MONSERRAT 1994, 1996, SZIRÁKI 1992). Within this large area, surely because of the presence of woodlands, the species richness is the highest in Yemen, and probably, the number of the hitherto undescribed species may be rather high as well. This is supported by the present material in which the majority of the included species belongs to undescribed ones.

MATERIALS AND METHODS

In the extraordinarily large coniopterygid material (about 800 specimens) collected mostly by A. VAN HARTEN in Yemen, there were 399 male specimens. The majority of the coniopterygids was captured by light traps or with Malaise trap at Sana, but some specimens was found in other localities of the country. If the collecting method was other than mentioned above, it is noted in the text. Similarly, the collectory name is mentioned if it is other than A. VAN HARTEN.

As regards the male terminalia, I follow the terminology used by MEINANDER (1972*a*), however, in the case of some unusual sclerites or structures the questionable details are labelled on the corresponding figures.

In the examined material there was also a large number of females and in some cases it was possible to match them to the corresponding males with rather high probability. However, the majority of the data concerning the females will be published in another paper. Only *Aleuropteryx arabica* (which was represented by two females) is presented in this report.

TAXONOMICAL PART

Aleuropteryx arabica MEINANDER, 1977

Material: Shuqra, Laudar, March 21, 1993: one female specimen; Mafhaq, Chamis Bani Saad, March 9, 1993: an other female specimen.

As the eidonomic features of the examined specimens agree well with those described by MEINANDER in the case of the male holotype (MEINANDER 1977), the two collected specimen may be regarded as females of *A. arabica*. Since after the original description this species was already mentioned by MONSERRAT (1996) from Yemen, it is presumably not rare in this country.

Coniocompsa arabica SZIRÁKI, 1992

Material: Wadi Bana, March 20, 1993: one male specimen.

The examined coniopterygid is identical in every respect with the holotype of the species, which was described from Wadi Zabid (Yemen).

Cryptoscenea hoelzeli sp. n.
(Figs 1–4)

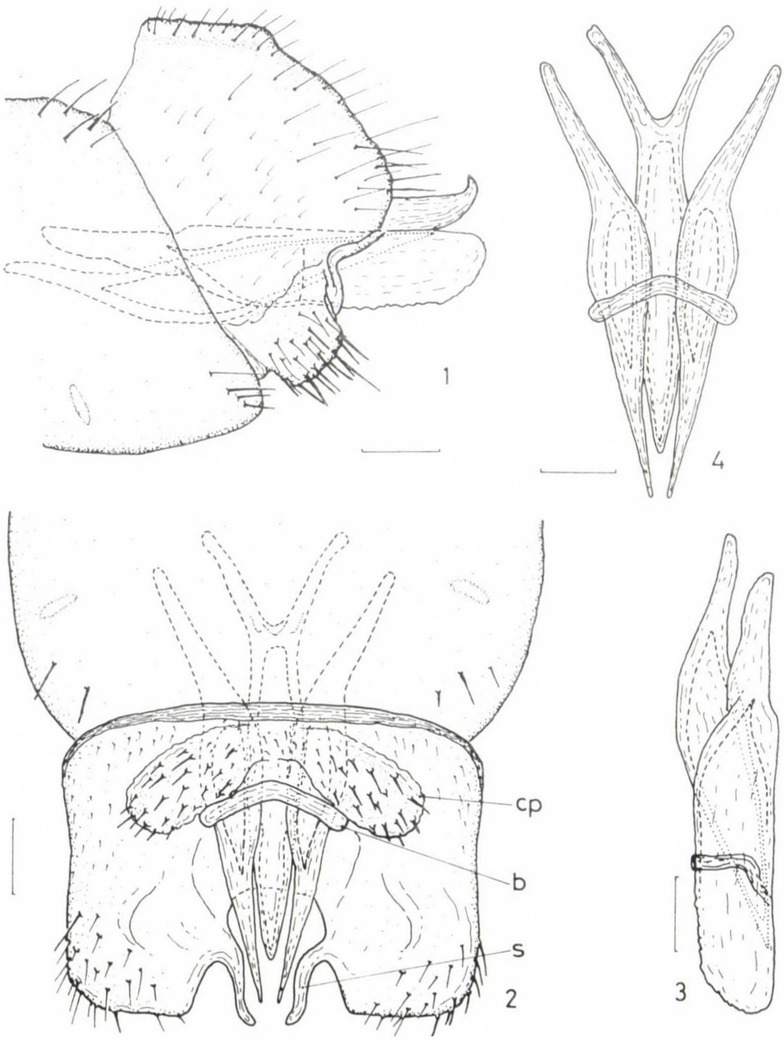
Holotype: male, "Yemen, Sana, May 1991, VAN HARTEN" – deposited in the Hungarian Natural History Museum, Budapest.

Description: Frons moderately, but distinctly sclerotized between the antennae. Maxillary palpi slender. Colour of the head capsule and of the thorax mostly lost before the examination. Eyes small and black. Antennae 1.3 mm, 24 segmented. Pedicel one and a half times as long as wide, basal flagellar segments about as long as wide, median flagellar segments almost twice as long as wide. All surface of the flagellar segments and of pedicel covered by fine ordinary hairs. The elongated prothorax one and a half times as long as wide. Setae on first femur thin, but longer than those on meso-, and metathoracal ones. Length of forewing 2.4 mm, of hind wing 2.0 mm. Both wing pairs two and a half times as long as broad. Venation typical for the genus. Longitudinal veins light brown. Anal region of hind wing narrow, fringers rather long.

Male terminalia: as in Figs 1–4. Border between ninth and tenth tergites indiscernible. Anterior edge of ninth sternite with distinct apodeme. Coxopodites stalked, their base situated almost medially. At base of sinuated styli ventral to parameres a narrow, strongly chitinized belt present.

Parameres about as long as penis, and in lateral view broad. Their distal part toothed ventrally. Penis acute caudally, most of it tubular.

Remarks: The new species greatly differs from the earlier known *Cryptoscenea*, but resembles *C. ohmi* (described below) because of the long flagellar segments and the broad paramere.

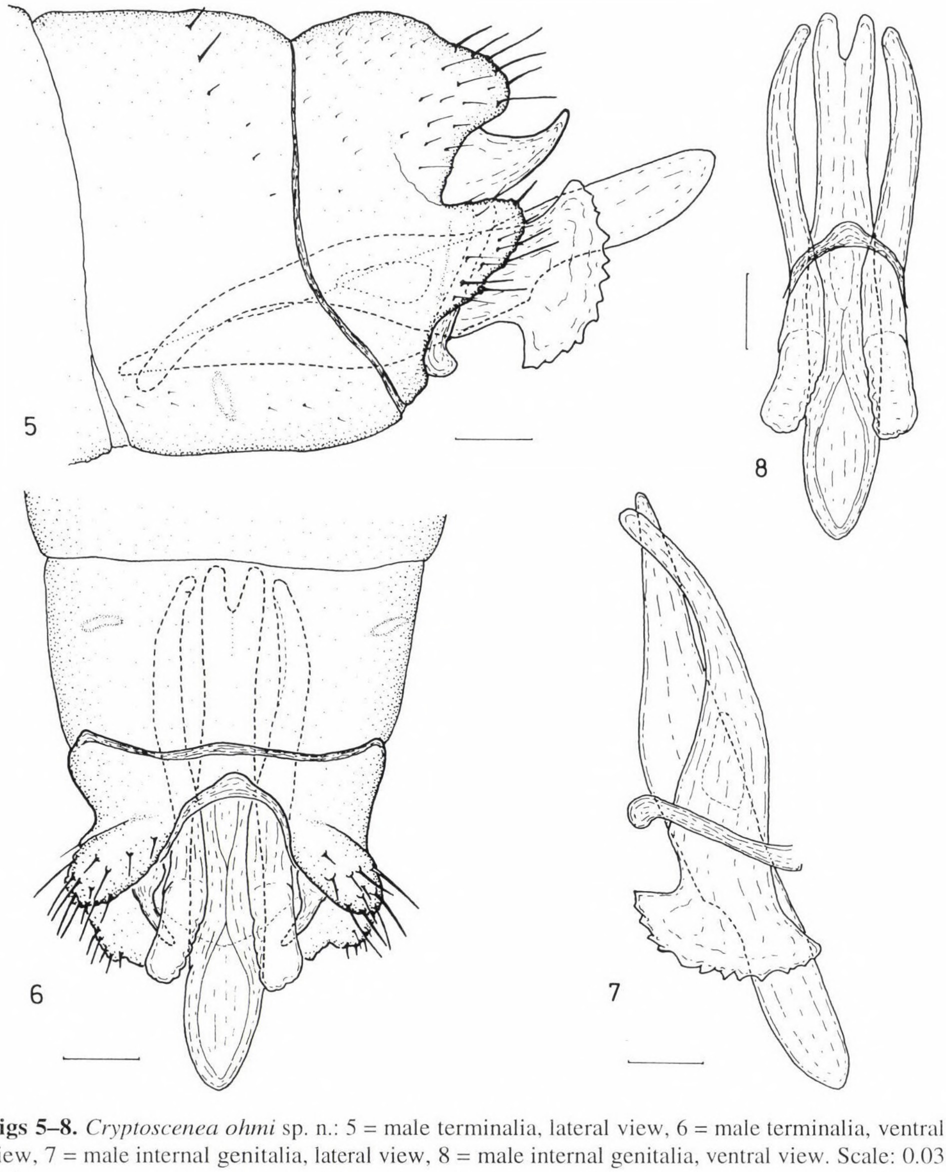


Figs 1–4. *Cryptoscenea hoelzeli* sp. n.: 1 = male terminalia, lateral view, 2 = male terminalia, ventral view, 3 = male internal genitalia, lateral view, 4 = male internal genitalia, ventral view. Scale: 0.03 mm, cp= coxopodite, b= chitinized belt, s= stylus

The main distinctive characteristics of *Cryptoscenea hoelzeli* sp. n. are:

- elongated prothorax;
- relatively long flagellar segments;
- apart from its proximal end, an evenly broad paramere in lateral view.

Etymology – I name this new species in honour of Mr. HERBERT HÖLZEL, one of the most venerable neuropterologists.



Figs 5–8. *Cryptoscenea ohmi* sp. n.: 5 = male terminalia, lateral view, 6 = male terminalia, ventral view, 7 = male internal genitalia, lateral view, 8 = male internal genitalia, ventral view. Scale: 0.03 mm

Cryptoscenea ohmi sp. n.
(Figs 5–8)

Holotype: male, "Yemen, Sumara Pass between Yarim and Ibb, March 22, 1992, VAN HARTEN" – deposited in the Hungarian Natural History Museum, Budapest.

Description: Except the eyes, colour lost before examination. Frons between antennae moderately, but distinctly sclerotized. Maxillary palpi slender. Eyes black. Antennae 1.7 mm, 25-segmented. Pedicel one and a half times as long as broad, some of basal flagellar segments about as long as broad, while median flagellar segments two times longer than broad. Whole surface of flagellar segments covered by fine ordinary hairs.

Fore wing narow, three times as long as broad, its length 2.3 mm. Two basal costal cross veins present. Hind wing with typical features of the genus: long (almost three times as long as broad) with narrow anal region. Between veins M and Cu1 no membrane for more than half of the length of Cu1. Marginal fringers prominent. Length of hind wing: 2.0 mm.

Male terminalia: as in Figs 5–8. Ninth sternite well sclerotized. Border between ninth and tenth tergite indistinct. Coxopodites rather large, subtriangular, rounded caudally. Styli slightly curved invards. Between the bases of styli a strongly chitinized belt present. Distal end of parameres abruptly broadened, and caudal edge of this broadening toothed. Penis longer than parameres and in ventral view narrow. Its large part tubular.

Remarks: The new species is rather distinct from all the hitherto described *Cryptoscenea* species. On the other hand, in some respects (e.g. long flagellar segments) it resembles *C. hoelzeli* sp. n. described above. The main distinctive characteristics of *Cryptoscenea ohmi* sp. n. are:

– two basal cross weins in the costal area;
– long median flagellar segments;
– peculiar shape of the paramere in the male genitalia with abruptly broadened, caudally toothed distal end.

Etymology – I dedicate this new coniopterygid to Dr. PETER OHM, the excellent German neuropterologist.

Helicoconis (Fontenellea) beata sp. n.
(Figs 9–12)

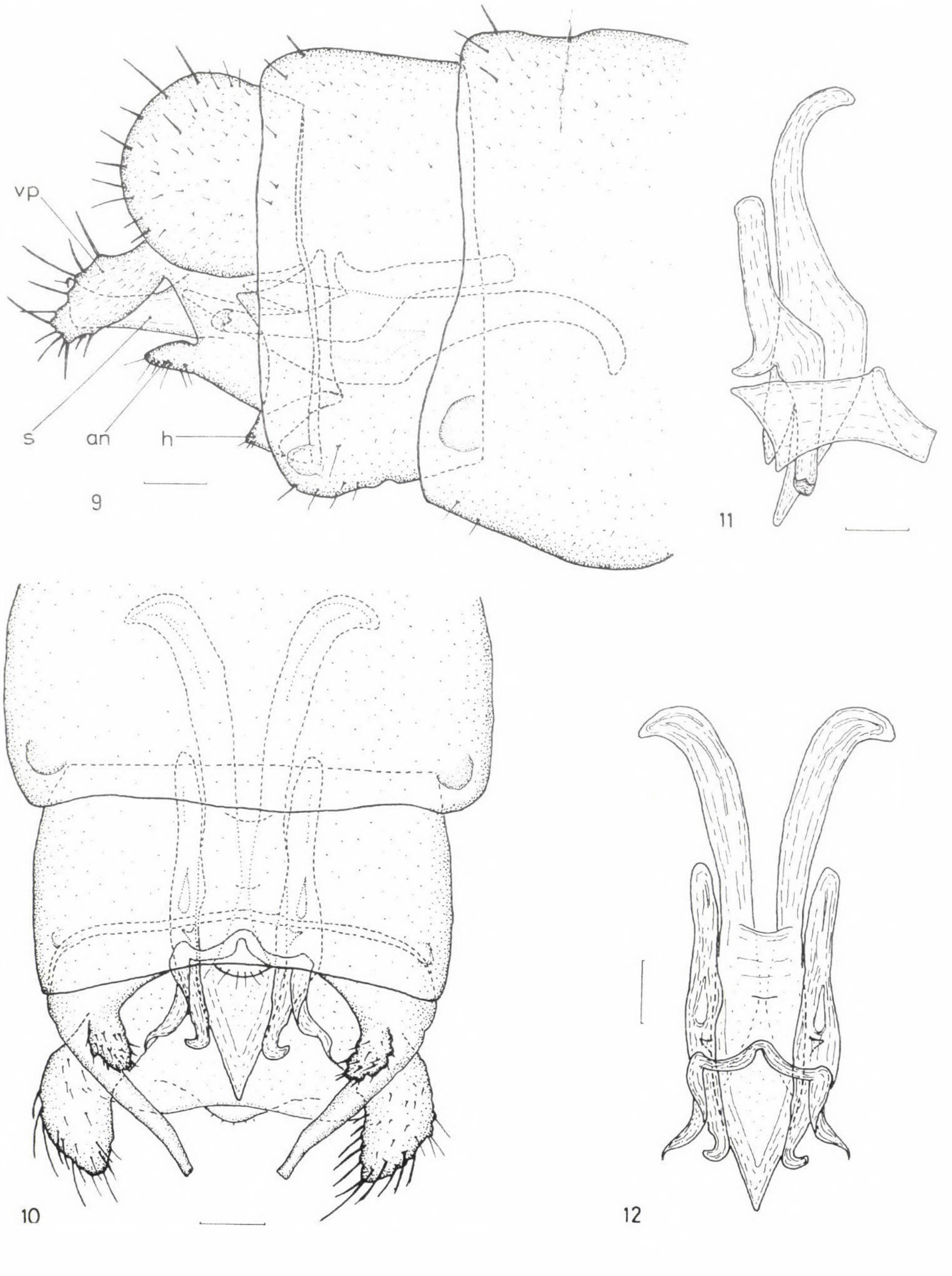
Holotype: male, "Yemen, Sana, September 1992, VAN HARTEN" – deposited in the Hungarian Natural History Museum, Budapest. Paratype: 1 male, same data as holotype – deposited in the Hungarian Natural History Museum, Budapest.

Description: Frons distinctly sclerotized between antennae. Head capsule brown, eyes black. Maxillary palpi slender. Antennae 1.7 mm, 26–27-segmented. Pedicel and basal flagellar segments one and a half times as long as broad, median flagellar segments about twice as long as broad. Whole surface of antennal segments covered by ordinary hairs.

Length of forewing 2.7 mm, of hind wing 2.4 mm. Both wings about two and a half times as long as broad. Anal region of hind wings wide, their fringers short.

Male terminalia: as in Figs 9–12. Ninth segment narrow. Appendage of ninth sternite rather weak. Hypandrium narrow with haired caudal edge. Styli long. Ventral projection of ectoproct

Figs 9–12. *Helicoconis beata* sp. n.: 9 = male terminalia, lateral view, 10 = male terminalia, ventral view, 11 = male internal genitalia, lateral view, 12 = male internal genitalia, ventral view. Scale: 0.03 mm, an= appendage of ninth sternite, h= hypandrium, s= stylus, vp= ventral projection



slender and stalked. Penis sclerites fused from half of their length, and with a short straight, caudally directed dorsal tooth. Apices of parameres curved sharply outwards. Parameres with large, in lateral view slightly curved dorsal projection.

Remarks: Because of the structure of male genitalia (e.g. caudally directed dorsal projection of the penis), the new species is closely allied with *H. hispanica* OHM, 1965 and *H. iberica* OHM, 1965 (OHM 1965, Figs 37–44*c*). Main distinctive characteristics of the *Helicoconis beata* sp. n. are:

- frons distinctly sclerotized between the antennae;
- paramere has a strong dorsal projection.

Etymology – the new species was named in connection with the less frequently used latin name of Yemen: Arabia Beata.

Nimboa marroquina MONSERRAT, 1985

Material: Sana, February 1991: one male specimen.

Hitherto this species was known from different parts of Africa (MONSERRAT 1994).

Nimboa sumarana sp. n.
(Figs 13–19)

Holotype: male, "Yemen, Sumara Pass between Yarmin and Ibb, March 22, 1992, VAN HARTEN" – deposited in the Hungarian Natural History Museum, Budapest.

Description: Frons narrow. Apical edge of third segment of palpus maxillaris with distinct dorsal projection oriented forwards (Fig. 13). Except for eyes, colour of studied coniopterygid lost before investigation. Eyes black. Antennae 1.4 mm, 29-segmented. Pedicel one and a half times as long as broad. Ordinary hairs in two, more or less regular whorls. Rather long scale-like hairs situated also in two whorls before each whorls of ordinary hairs on flagellar segments (as in *N. pallida* SZIRÁKI et GREVE 1996), while whole surface of pedicel covered by rather short scale-like hairs.

Length of forewings 2.3 mm, of hind wings 1.8 mm. Wing membrane without spots. Male terminalia: as Figs 14–19. Hypandrium long, in ventral view proximally narrow, distally wide with rounded caudal edge. Proximal part of hypandrium broadly synscleritous with ectoprocts. Latter ventrally with a curved, sclerotized apodeme. Styli forked with long, pointed branches. Paramere long with distinct, but rather small dorsal arch. Caudal end of paramere broad and curved upwards. Penis in dorsal view triangular. Ductus ejaculatorius chitinized. Above paramere a laterally visible, moderately sclerotized sheet.

Remarks: Because of the unspotted wing membrane and of the long, caudally broad and curved paramere, *Nimboa sumarana* is close to *Nimboa espanioli* OHM, 1973 (OHM 1973, Figs 4–5). The main distinctive features of *N. sumarana* sp. n. are:

- long, caudally broad and curved paramere with distinct dorsal branch (while in *N. espanioli* the dorsal branch is absent);
- long, proximally narrow, distally wide hypandrium with rounded caudal edge;
- proximal part of hypandrium broadly synscleritous with ectoprocts.

Coniopteryx (Xeroconiopteryx) ketiae MONSERRAT, 1985

Material: Hamam Ali, August 8, 1991: 1 male, February 16, 1992: 1 male; Sana, February 1991: 1 male, July 1991: 78 males, August 1991: 34 males, October 1991: 13 males, April 1992: 3 males, September 1992: 5 males.

Hitherto this species was reported only from the Iberian Peninsula (MONSERRAT 1994). Its occurence in Yemen shows that this species probably has a large range in the semiarid areas of western Palaearctis.

Coniopteryx (Xeroconiopteryx) ujhelyii SZIRÁKI, 1992

Material: Sana, July 1991: 2 males, September 1991: 1 male.

This species was described from Yemen (SZIRÁKI 1992). The examined specimens agree completely with the type material, but the sclerotization of their terminalia is somewhat stronger.

Coniopteryx (Xeroconiopteryx) unicef MONSERRAT, 1996

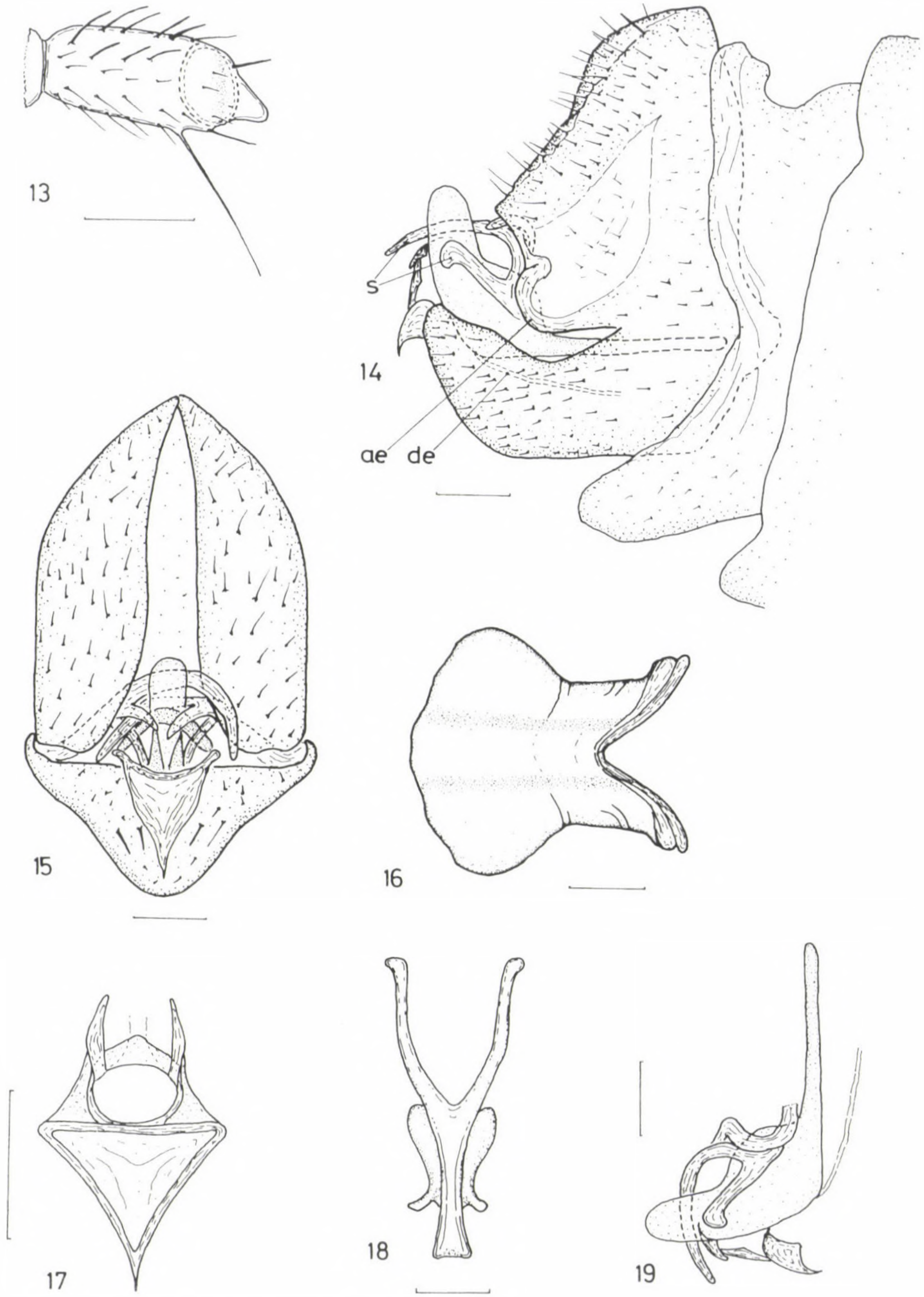
Material: Sana, July 1991: 85 males, August 1991: 70 males, September 1991: 3 males, April 1992: 14 males.

This very characteristic species was recently described from Yemen (MONSERRAT 1996). It is reported also from Iran (MEINANDER 1997), and in the examined material this species is the most abundant coniopterygid.

Coniopteryx (Xeroconiopteryx) venustula RAUSCH et ASPÖCK, 1978

Material: Aden, April 10–12, 1993: 2 males.

C. (X.) venustula was earlier reported from Iran and Sri Lanka (MEINANDER 1990) and recently also from Yemen (MONSERRAT 1996). Its presence in the examined material confirms that this species has a large range in the southern Asia.

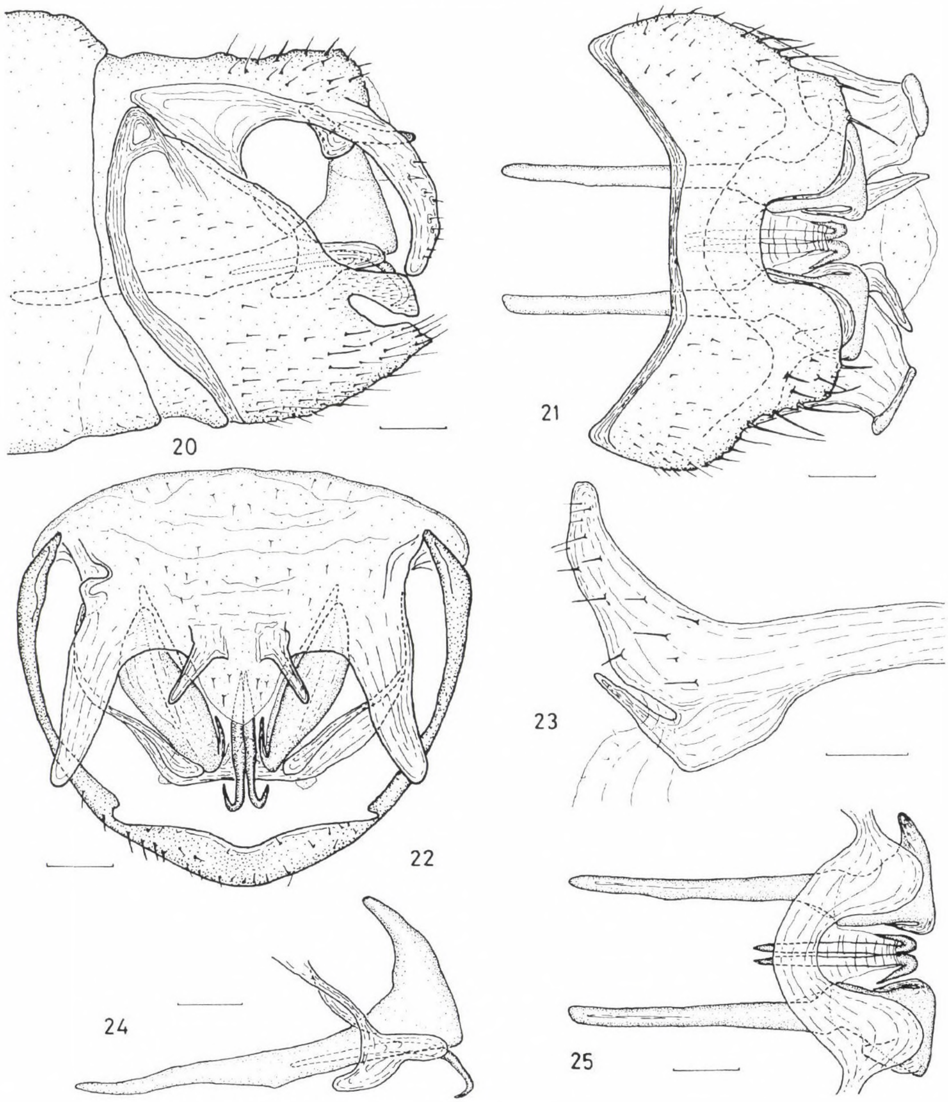


Figs 13–19. *Nimboa sumarana* sp. n.: 13 = third segment of palpus maxillaris, dorsal view, 14 = male terminalia, lateral view, 15 = male terminalia, caudal view, 16 = hypandrium, ventral view, 17 = penis, dorsal view, 18 = paramere and styli, ventral view, 19 = paramere and styli, lateral view. Scale: 0.03 mm, ae= ventral apodeme of ectoproct, de= ductus ejaculatorius, s= stylus

Coniopteryx (Xeroconiopteryx) wittmeri MEINANDER, 1979

Material: Sana, July 1991: 5 males, August 1991: 5 males, September 1991: 1 male.

The known range of this species is restricted to the south-western part of the Arabian Peninsula (MEINANDER 1979, MONSERRAT 1996).



Figs 20–25. *Coniopteryx (X.) appendiculata* sp. n.: 20 = male terminalia, lateral view, 21 = male terminalia, ventral view, 22 = male terminalia, caudal view, 23 = gonarcus with its internal appendage, dorso-lateral view, 24 = male internal genitalia, lateral view, 25 = male internal genitalia, ventral view. Scale: 0.03 mm

Coniopteryx (Xeroconiopteryx) appendiculata sp. n.
(Figs 20–25)

Holotype: male, "Yemen, Sana, September 1992, VAN HARTEN" – deposited in the Hungarian Natural History Museum, Budapest.

Description: Structure of frons and palpi normal. Vertex and frons pale yellowish brown, genae light brown. Eyes black. Antennae 1.0 mm, 26 segmented, light brown. Pedicel somewhat longer than broad, basal flagellar segments about twice as broad as long. Scale-like hairs on whole surface of pedicel and first few flagellar segments, as well as on apical part of other flagellar segments. Setae present on flagellar segments except basal ones; ordinary hairs mostly in two irregular whorls.

Thorax pale ochreous with light brown shoulder spots and sutures. Length of forewing 1.75 mm, of hind wing 1.6 mm. Wing membrane hyaline.

Male terminalia: as in Figs 20–25. Hypandrium in lateral view about as high as broad. Apodeme along anterior margin ventrally complete. Processus terminalis distinct with large, U-shaped median apical incision. Ventral part of processus lateralis forming a long, well-separated narrow lobe, while its dorsal part indistinct. Gonarcus extraordinarily long, bent downwards, and with a strong, straight, thorn-like internal appendage. Styli forked; its outer branches very broad, while inner ones forming an arch below parameres. Parameres long with strong, acute processus apicalis, latter with thin basal duplication medially. Processus ventralis indistinct. Penis consisting of two thin sclerites; their pointed tips ventrally curved forward. Penis sclerites supported by structure originated from the stylus arch below parameres.

Remarks: Because of the straight caudal thorn on the gonarcus, the strong, pointed processus apicalis of parameres, and the similarities in the structure of the processus lateralis of the hypandrium, *C. (X.) appendiculata* resembles *C. (X.) mucrogonarcuata* MEINANDER, 1979 (MEINANDER 1979, Fig. 5). The main distinctive characteristics of the new species are:

- the extraordinarily long gonarcus;
- the forked styli;
- the large, U-shaped median apical incision of the processus terminalis on the hypandrium.

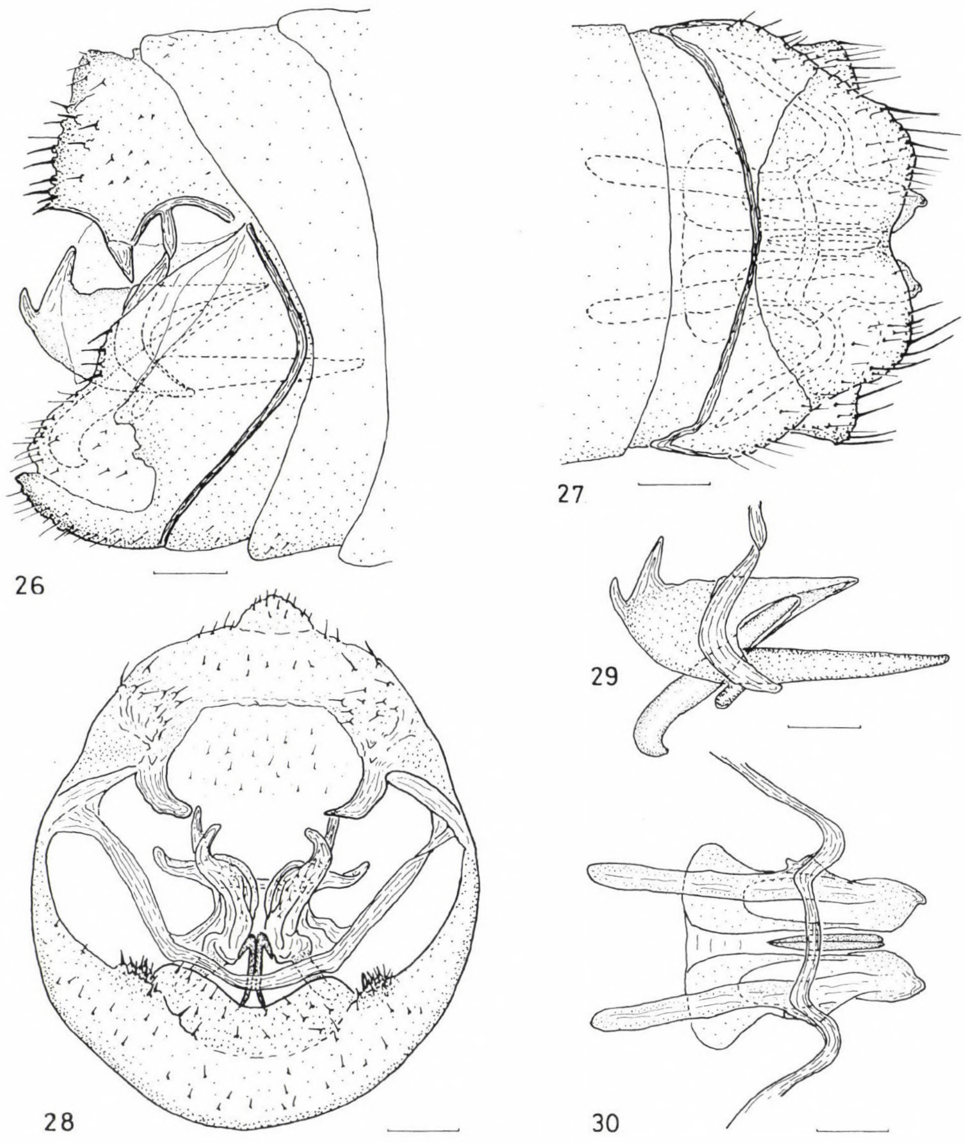
Coniopteryx (Xeroconiopteryx) collaris sp. n.
(Figs 26–30)

Holotype: male, "Yemen, Al Kowd, January 18–30, 1993, VAN HARTEN" – deposited in the Hungarian Natural History Museum, Budapest. Paratypes: 1 male, same data as holotype; 1 male, same locality as holotype, February 1–14, 1993 – deposited in the Hungarian Natural History Museum, Budapest.

Description: Structure of frons and palpi normal. Colour of studied insects, apart from eyes of holotype, lost before examination. Eyes black, moderately large. Antennae 1.1–1.2 mm, 25–27-segmented. Pedicel one and a half times as long as broad. Basal flagellar segments about as long as broad, while middle ones somewhat longer than broad. Scale-like hairs on apex of flagellar seg-

ments. Setae present on flagellar segments except basal ones. Ordinary hairs situated in two rather irregular whorls. Length of forewing 1.5–1.7 mm, of hind wing 1.3–1.4 mm.

Male terminalia as in Figs 26–30. Hypandrium in lateral view about twice as high as broad. Apodeme along anterior margin ventrally complete. Processus terminalis caudally rounded with shallow median incision. Large part of processus lateralis rather indistinct, apart from its setose ventral angle. Dorso-caudally of this organ a mostly membraneous projection present, but its distal



Figs 26–30. *Coniopteryx (X.) collaris* sp. n.: 26 = male terminalia, lateral view, 27 = male terminalia, ventral view, 28 = male terminalia, caudal view, 29 = male internal genitalia, lateral view, 30 = male internal genitalia, ventral view. Scale: 0.03 mm

part more sclerotized with a distinct caudal edge. Gonarcus short but broad, and with a strong, curved internal appendage. Processus ventralis of paramere well-developed. Processus apicalis with two dorsal projections; caudal one bent inwards. Besides, a more or less collar like structure originated from processus apicalis of both parameres, and these structures connected to each other by dorsal plate. Styli with a stronger ventral, and a weaker dorsal branch. Ventral branches forming an arch below parameres, while dorsal ones attached to above – mentioned collar – like structures. Penis consisting of two hooked, in lateral view rather wide sclerites.

Remarks: Because of the short and broad gonarcus with strong inner appendage, and the similarities in the structure of hypandrium, the new species is close to the *Coniopteryx (X.) latigonarcuata* MEINANDER, 1972 (MEINANDER 1972*b*, Fig. 2). The main distinctive features of *Coniopteryx (X.) collaris* sp. n. are:

- collar-like sclerotized structure above the middle part of the paramere;
- pointed and curved caudal appendage of the processus apicalis on the paramere;
- relatively long flagellar segments of the male antennae.

Coniopteryx (Xeroconiopteryx) makarkini sp. n.
(Figs 31–36)

Holotype: male, "Yemen, Sana, August 1991, VAN HARTEN" – deposited in the Hungarian Natural History Museum, Budapest.

Description: Structure of frons and palpi normal. Genae below eyes, frons, frontal edge of vertex and clypeus medium brown. Other parts of genae and vertex, as well as antennae and palpi light brown. Antennae 1.5 mm, 29-segmented. Pedicel twice as long as broad, first flagellar segment one and a half times as long as broad, third flagellar segment about as long as broad, while median and apical flagellar segments about twice as long as broad. Setae present on flagellar segments and pedicel. Most of ordinary hairs arranged in two, more or less regular whorls, but some of them situated between these whorls. Scale-like hairs before both whorls of ordinary hairs. Eyes large, black.

Thorax light brown, but its ventral side, shoulder spots and a little spot below first wing dark brown. Legs light brown also. Length of forewing 1.8 mm, of hind wing 1.5 mm. Wing membrane fuscous brown.

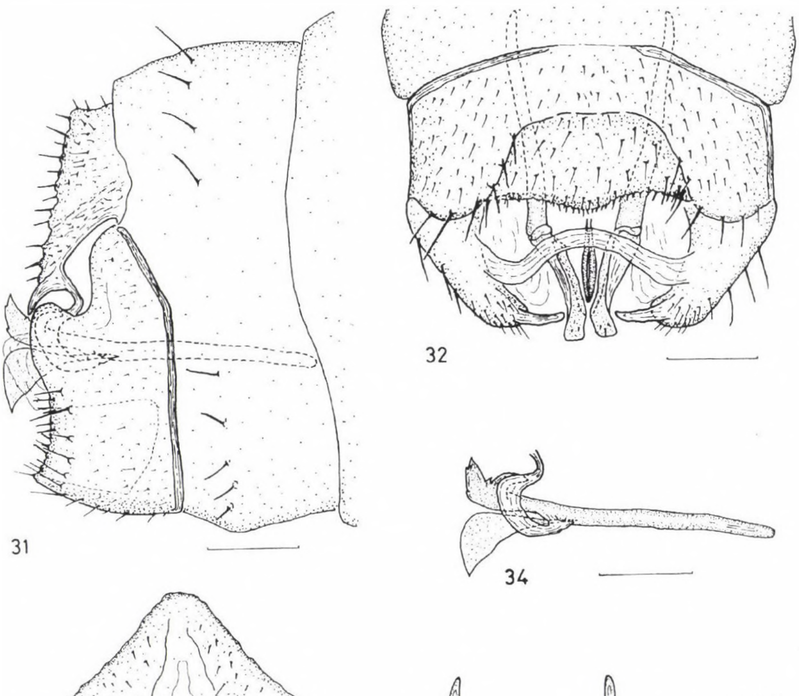
Male terminalia: as in Figs 31–36. Hypandrium in lateral view about twice as high as broad. Apodeme along anterior margin very narrow, and ventrally incomplete. Processus terminalis very short without median apical incision. Processus lateralis moderately developed with a distinct upper angle. Its internal projection weakly chitinized. Gonarcus narrow, bent downwards and inwards, and with a long, slender apical thorn. Ventral apodeme of gonarcus narrow. Unforked styli forming an arch below parameres, and attached to gonarcus rather close to base of its apical thorn. Between ectoprocts a moderately sclerotized, rounded conic projection. Processus ventralis of long and slender paramere short. Processus apicalis bifurcated; caudal projection short, while proximal one, originating from inner side of paramere, longer, and bent forwards. At base of both projections apparently a minute knob. Penis consisting of two short, but wide, curved sclerites.

Remarks: Because of the similar structure of the hypandrium, and the long, pointed apical thorn of the gonarcus, and because of the short, curved penis and

the long, slender parameres, the new species resembles *Coniopteryx (X.) rostrogonarcuata* H. ASPÖCK et U. ASPÖCK, 1968 (ASPÖCK & ASPÖCK 1968, Fig. 1). The main distinctive characteristics of *Coniopteryx (X.) makarkini* sp. n. are:

– characteristic structure of the processus apicalis of the paramere;
– narrow gonarcus with long, but slender apical projection;
– styli attached to the gonarcus near to the base of its apical thorn.

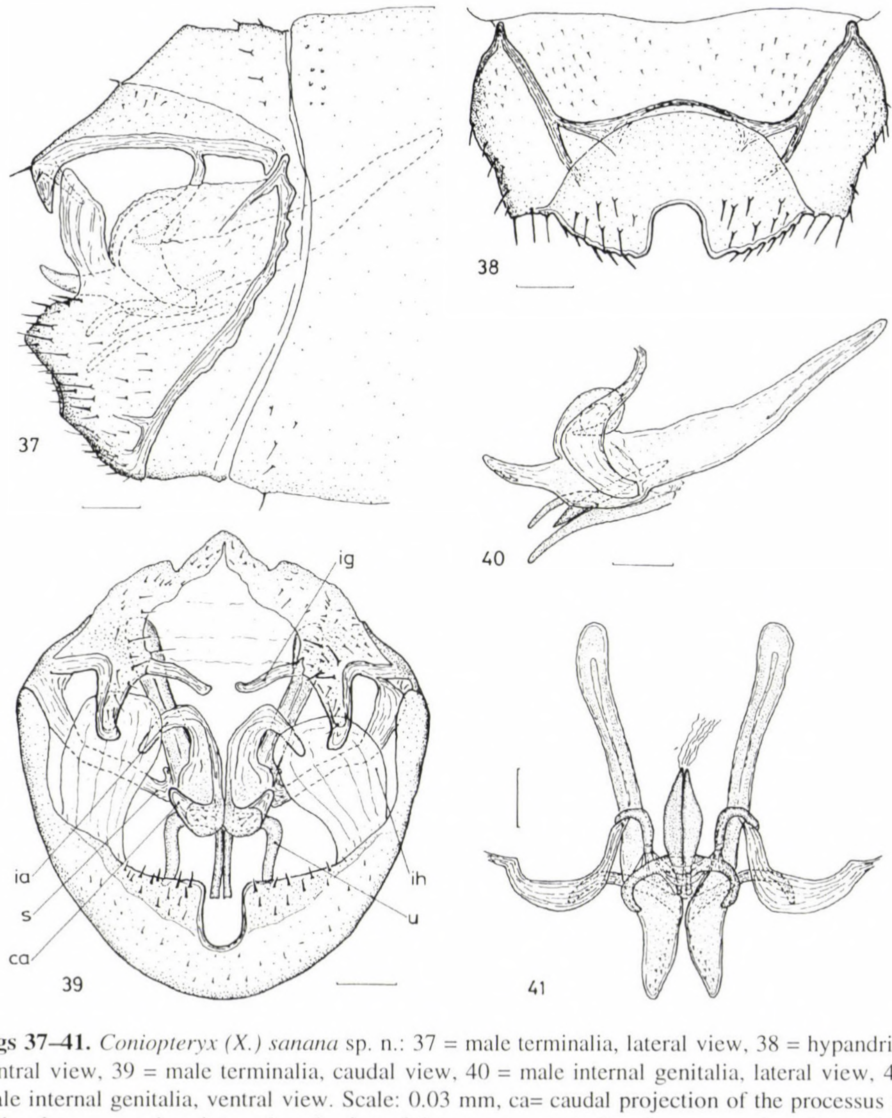
Etymology – I name this new species in honour of Dr. V. N. MAKARKIN, the excellent Russian neuropterologist.



Figs 31–36. *Coniopteryx (X.) makarkini* sp. n.: 31 = male terminalia, lateral view, 32 = male terminalia, ventral view, 33 = male terminalia, caudal view, 34 = male internal genitalia, lateral view, 35 = male internal genitalia, ventral view, 36 = caudal part of paramere, dorso-lateral view. Scale: 0.03 mm

Coniopteryx (Xeroconiopteryx) sanana sp. n.
(Figs 37–41)

Holotype: male, "Yemen, Sana, August 1991, VAN HARTEN" – deposited in the Hungarian Natural History Museum, Budapest. Paratypes: 2 males, same data as holotype; 2 males, same locality as holotype, July 1–15, 1991; 1 male, same locality as holotype, September 1991; 1 male, Yemen, Al Kowd, February 1–14, 1993 – deposited in the Hungarian Natural History Museum, Budapest.



Figs 37–41. *Coniopteryx (X.) sanana* sp. n.: 37 = male terminalia, lateral view, 38 = hypandrium, ventral view, 39 = male terminalia, caudal view, 40 = male internal genitalia, lateral view, 41 = male internal genitalia, ventral view. Scale: 0.03 mm, ca= caudal projection of the processus apicalis of paramere, ia = internal projection of the processus apicalis of paramere, ig = internal projection of gonarcus, ih = internal projection of hypandrium, s = stylus, u = U-shaped sclerite

Description: Structure of frons and palpi normal. Vertex and frons pale yellowish brown, genae and clypeus medium brown. Eyes black. Antennae 1.0–1.2 mm, 26–28-segmented, brown, but flagellum somewhat darker than pedicel. The latter almost one and a half times as long as broad, while shape of flagellar segments rather variable: in some cases basal flagellar segments as long as broad, while in other cases one and a half times as broad as long. In some cases median flagellar segments about as long as broad, while in other cases distinctly longer than broad. Setae present on flagellar segments and pedicell as well. Most of ordinary hairs arranged in two more or less regular whorls, but some of them are between these ones. Scale-like hairs before whorls of ordinary hairs.

Thorax mostly pale ochreous, but its ventral parts, legs and shoulder spots brown. Length of fore wing 1.5–2.1 mm, of hind wing 1.5–1.9 mm. Wing membrane fuscous brown.

Male terminalia: as in Figs 37–41. Hypandrium in lateral view somewhat higher than broad. Its anterior apodeme ventrally complete, bent backwards, and divided into branches. Processus terminalis broad with distinct, U-shaped median incision. Processus lateralis rather indistinct, however, a strong internal hyaline projection erected from its ventral part. Gonarcus broad with strong ventral apodeme. Its caudal end with a ventrally situated, stout thorn, while subapically a long internal projection on the gonarcus. Styli unforked without arch below parameres. Internal projection on processus apicalis of paramere extremely large, and curved outwards and backwards. Caudal projection of processus apicalis rounded lance-shaped. An unusual, wide, U-shaped sclerite, situated below processus apicalis and connected to paramere by a chitinous bound originating at small processus ventralis, and in connection with penis sclerite as well. Latter consisting of two pointed rods.

Remarks: Because of the structure of the processus lateralis of hypandrium, and the long internal projection of gonarcus, the new species is close to the *Coniopteryx (X.) orba* RAUSCH et ASPÖCK, 1977 (RAUSCH & ASPÖCK 1977, Fig. 3). The main distinctive features of *Coniopteryx (X.) sanana* sp. n. are:

- strong, stout caudal thorn of the gonarcus together with a long internal projection;
- curious, curved outward and backward internal projection of the processus apicalis of paramere;
- unusual, wide, U-shaped sclerite ventrally of the paramere, which is connected to the penis and the parameres.

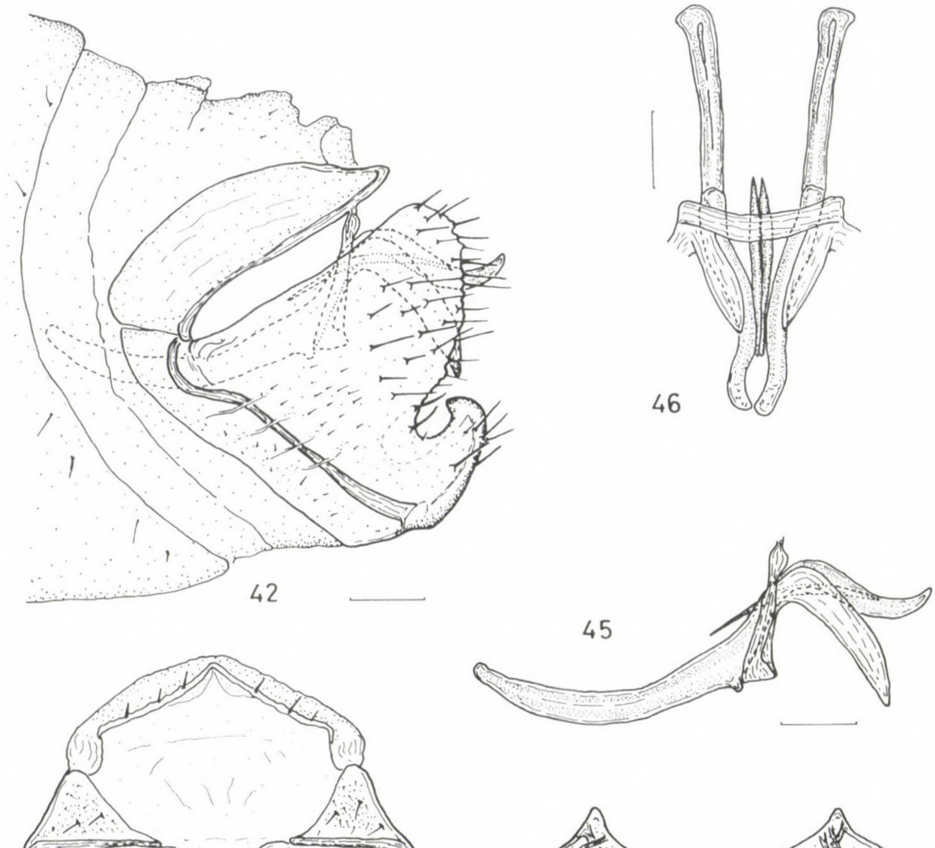
Coniopteryx (Coniopteryx) curvicaudata sp. n.
(Figs 42–46)

Holotype: male, "Yemen, Hamam Ali, August 5, 1991, beaten from Citrus, VAN HARTEN" – deposited in the Hungarian Natural History Museum, Budapest.

Description: Structure of frons and palpi normal. Colour of studied insect apart from eyes lost before investigation. Eyes black. Antennae 1.0 mm, 26-segmented. Pyriform pedicel about as long as broad. Basal flagellar segments twice, median ones one and a half times as broad as long. Setae present on flagellar segments. Ordinary hairs situated in irregular way on most segments, but on basal ones mostly in two, more or less regular whorls. Scale-like hairs on whole surface of pedicel, and on apical part of flagellar segments. Length of forewing 2.1 mm, of hind wing 1.7 mm.

Male terminalia: as in Figs 42–46. Hypandrium in lateral view about as high as broad. Ventrally complete anterior apodeme separated from anterior margin, and strongly curved backwards

medially. Processus terminalis moderately long. Its caudal part curved upwards; in lateral view hooked. Median apical incision in caudal view distinct, U-shaped. Processus lateralis well-chitinized, long; its caudal edge rounded. Styli forked. Their outer branches rather wide, while inner ones forming an arch below parameres. Parameres long with distinct processus ventralis. Caudal part of parameres slightly S-shaped without distinct processus apicalis. Penis consisting of two rather long and slender sclerites.



Figs 42–46. *Coniopteryx (C.) curvicaudata* sp. n.: 42 = male terminalia, lateral view, 43 = hypandrium, ventral view, 44 = male terminalia, caudal view, 45 = male internal genitalia, lateral view, 46 = male internal genitalia, ventral view. Scale: 0.03 mm

Remarks: In the male genitalia of *Coniopteryx curvicaudata* (such as the long paramere with S-shaped caudal part) and because of the structure of the processus terminalis), it resembles *Coniopteryx (C.) exigua* WITHYCOMBE, 1925 (MEINANDER 1972*a*, Fig. 154). The main distinctive characteristics of *Coniopteryx (C.) curvicaudata* sp. n. are:

- short ventral part of hypandrium;
- anterior apodeme of hypandrium medially strongly curved backwards;
- long, pointed and paired penis sclerites.

Coniopteryx (Coniopteryx) vanharteni sp. n.
(Figs 47–53)

Holotype: male, "Yemen, Hamam Ali, February 16, 1992, VAN HARTEN" – deposited in the Hungarian Natural History Museum, Budapest. Paratypes: 2 males, same data as holotype; 1 male, Yemen, Sumara Pass, March 13, 1993; Yemen, Wadi Warzan, March 14, 1993, leg.: M. KNAPP – deposited in the Hungarian Natural History Museum, Budapest.

Description: Structure of frons and palpi normal. At frontal edge of vertex a rounded conic projection with strong setae arising from ring-shaped bases. Behind this projection two other fields of same setae situated between eyes (Fig. 47). Colour of head light brown. Eyes black. Antennae 1.0–1.1 mm, 26–27-segmented. Pedicel one and a half times as long as broad, basal flagellar segments about twice as broad as long. Setae present on flagellar segments, ordinary hairs in two regular whorls. Scale-like hairs on whole surface of pedicel, and on apical part of flagellar segments.

Thorax ventrally light brown, laterally pale ochreous. Sutures, shoulder spots and little spot below wing base dark brown. Legs pale ochreous. Wing membrane light fuscous, longitudinal veins yellowish brown. On base of wings a little dark spot. In examined specimen distal M-Cu crossvein absent.

Male terminalia: as in Figs 48–53. Hypandrium in lateral view almost twice as high as broad. Apodeme along anterior margin ventrally complete. Processus terminalis short, broad with rather shallow median apical incision. Lower angle of processus lateralis acute. Apodeme along ventral side of gonarcus narrow. Styli forked. Their outer branches long, pointed and curved forwards. Inner branches forming a narrow arch below parameres. Parameres long, bent and slender, with distinct processus ventralis. Caudal part of parameres curved downwards with a little (in lateral view blunt) subapical dorso-caudal projection (processus apicalis). Penis consisting of two narrow, pointed sclerites.

Remarks: Because of the little processus apicalis on curved downwards paramere, the somewhat similar shape of the median apical incision of the procesus terminalis of the hypandrium, and because of the wide flagellar segments of the antennae, the new species is close to the widespread Palaearctic coniopterygid species *Coniopteryx (C.) pygmaea* ENDERLEIN, 1906 sensu GÜNTHER (1993) (MEINANDER 1972*a*, Fig. 157). The main distinctive characteristics of *Coniopteryx (C.) vanharteni* sp. n. are:

- setose, conic projection on the frontal edge of vertex;
- short processus terminalis of the hypandrium;

– small, in lateral view blunt dorso-caudal processus apicalis of the narrow paramere.

Etymology – I dedicate this new species to A. VAN HARTEN who collected most of the coniopterygids dealt in the present paper.

Conwentzia sabae sp. n.
(Figs 54–58)

Holotype: male, "Yemen, Jihana, January 21, 1992, singled from Cupressus, VAN HARTEN" – deposited in the Hungarian Natural History Museum, Budapest.

Description: Head light brown. Frons and palpi normal. Eyes moderately large, black. Antennae 2.2 mm, 37-segmented. Pedicel one and a half times as long as broad, basal flagellar segments as long as broad, while the median flagellar segments somewhat longer than broad. Ordinary hairs on whole surface of pedicel and flagellar segments. Moderately large setae present on flagellar segments.

Meso- and metathorax dorsally light brown. Other parts of body pale ochreous. Length of forewing 3.7 mm, of shortened hind wing 1.5 mm. Tibiae rather slender.

Male terminalia: as in Figs 54–58. Hypandrium with a broad apical incision and laterally separated from ninth sternite by a suture on both sides. Styli in lateral view narrow, with small ventral hook. Outer process of ectoproct in lateral view about as long as high. Inner process slender and relatively long. Its acute dorsal branch longer than ventral. Paramere long; its apical tooth strong, and sharply curved upwards. Sclerotized tenth sternite present with more chitinized dorsal surface. Penis short.

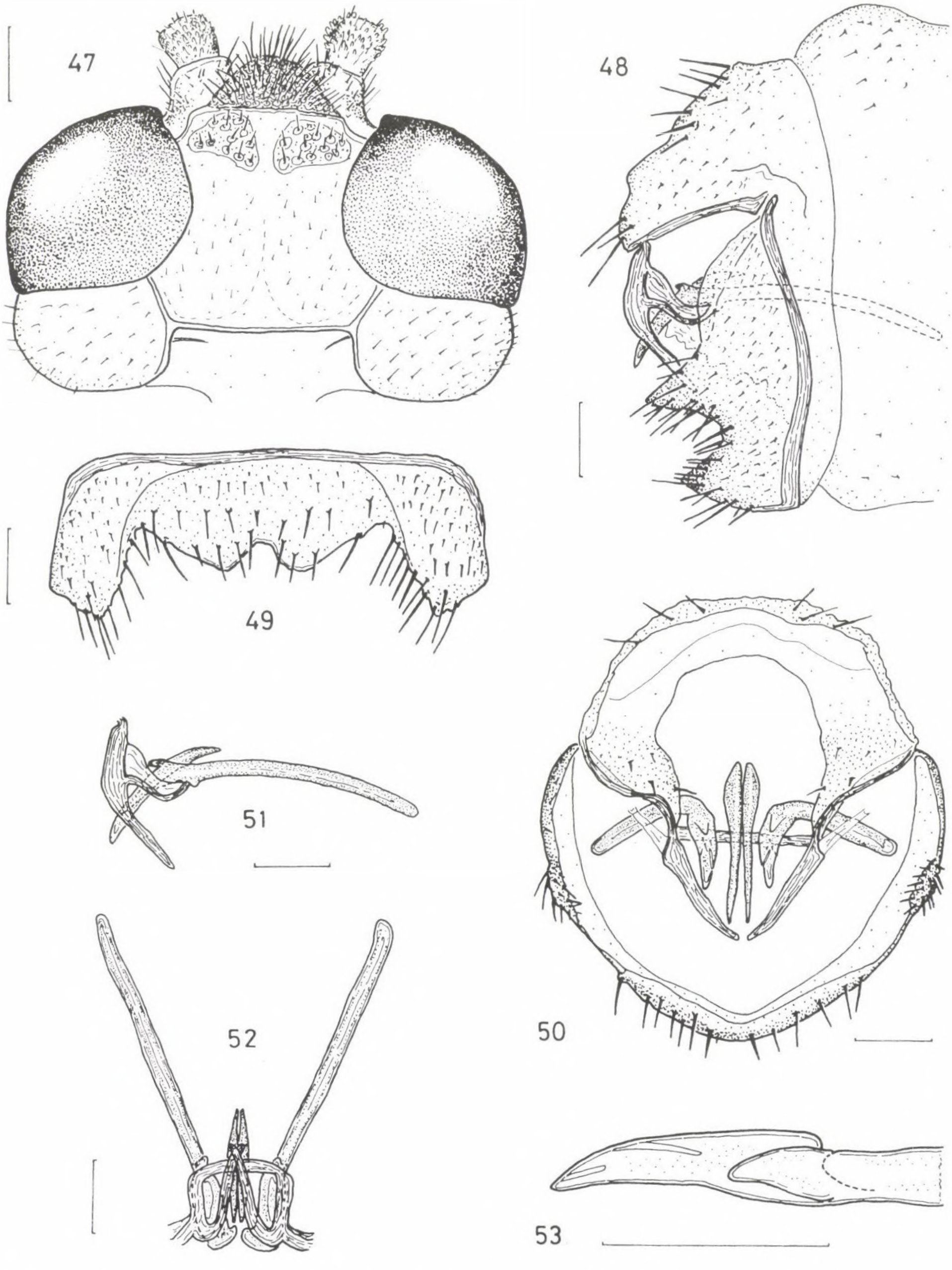
Remarks: Because of the rather distinct hypandrium separated from the ninth sternite by a suture, and the shape of the hypandrium, *Conwentzia sabae* resembles *C. orthotibia* YANG, 1974 (YANG 1974, Figs 11–12). The main distinctive characteristics of *Conwentzia sabae* sp. n. are:

– hypandrium separated from the ninth sternite by a medially interrupted suture (in *C. orthotibia* this suture is medially complete);
– paramere has a strong apical tooth curved sharply upwards;
– inner process of ectoproct is slender and relatively long (while that of *C. orthotibia* is short and stout).

Hemisemidalis kasyi (H. ASPÖCK et U. ASPÖCK, 1965)

Material: Al Kowd, October 27–November 15, 1992: 4 males, February 15–28, 1993: 1 male; Sana, January 1991: 1 male, August 1991: 2 males.

This coniopterygid has a large range from Yemen to Lebanon, Iran and Afghanistan (ASPÖCK & ASPÖCK 1965, MONSERRAT 1996, MEINANDER 1997).

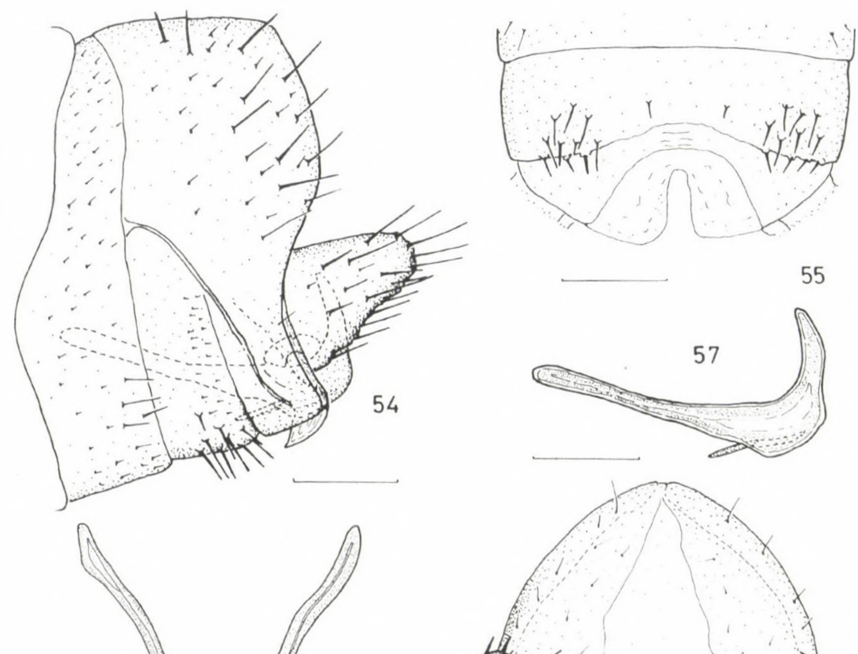


Figs 47–53. *Coniopteryx (C.) vanharteni* sp. n.: 47 = head, dorsal view, 48 = male terminalia, lateral view, 49 = hypandrium, ventral view, 50 = male terminalia, caudal view, 51 = male internal genitalia, lateral view, 52 = male internal genitalia, ventral view, 53 = caudal part of paramere, caudo-dorsal view. Scale: 0.03 mm

Semidalis scotti ESBEN-PETERSEN, 1928

Material: Qa Al Boun, October 1991: 4 males, beaten from apple and peach trees, leg.: M. KNAPP, February 1992: 2 males, beaten from apple tree, leg.: M. KNAPP; Sana, December 1990: 1 male, July 1–15, 1991: 10 males, February 1992: 2 males, September 1992: 3 males.

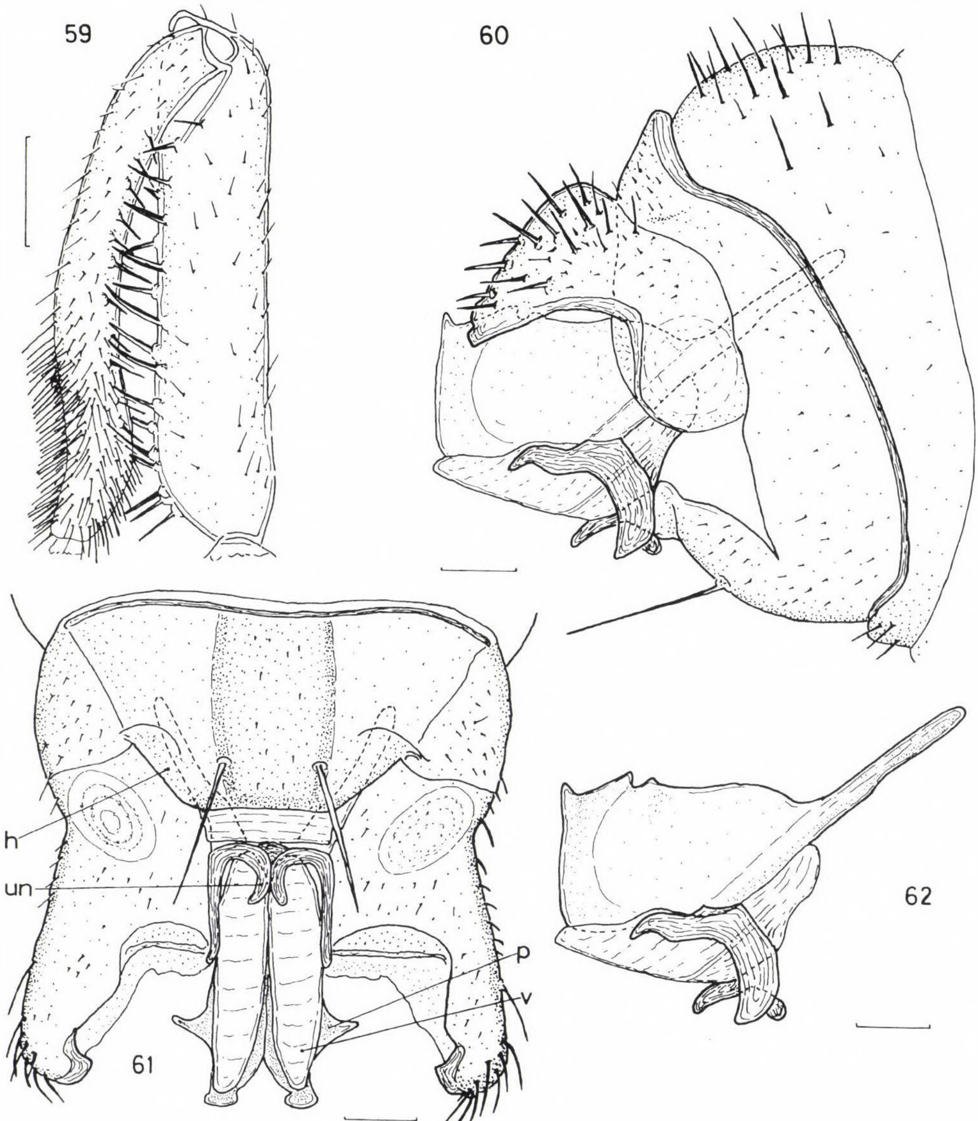
Earlier this species was recorded only from East Africa, however recently V. MONSERRAT found two male specimens in Yemen (MONSERRAT 1997). Its relatively large number in the present material shows that *S. scotti* might be a common species in this country.



Figs 54–58. *Conwentzia sabae* sp. n.: 54 = male terminalia, lateral view, 55 = hypandrium, ventral view, 56 = male terminalia, caudal view, 57 = paramere and penis, lateral view, 58 = male internal genitalia and ectoproct, ventral view. Scale: 0.06 mm, i= innern process of ectoproct, h = hypandrium, t = tenth sternite, s = stylus

Semidalis tenuipennis sp. n.
(Figs 59–62)

Holotype: male, "Yemen, Al-Hajjara, March 14, 1992, VAN HARTEN" – deposited in the Hungarian Natural History Museum, Budapest.



Figs 59–63. *Semidalis tenuipennis* sp. n.: 59 = first femur and tibia of male, 60 = male terminalia, lateral view, 61 = male terminalia, ventral view, 62 = male internal genitalia, lateral view. Scale in Fig. 59: 0.06 mm, in 60–63: 0.03 mm, h = hypandrium, p = paramere, un = uncini, v = ventral plate

Description: A very small *Semidalis* species. Colour of head and thorax (together with antennae and legs) light brown. Frons and palpi normal. Eyes small, black. Antennae 1.7 mm, 30-segmented. Pedicel and flagellar segments about one and a half times as long as broad. Ordinary hairs in two regular whorls on flagellar segments. Setae present on first part of these segments.

First legs obviously modified for a clasping function: femur and bent tibia provided with stout spines (Fig. 59). Length of forewing 1.8 mm, of hind wing 1.5 mm. Both fore – and hind wings narrow: three times as long as broad. Wing membrane light brown.

Male terminalia: as in Figs 60–62. Ectoproct large, distally with a stout inner thorn. Ventrally at base of ectoproct a round sclerotized area (distinctly visible in ventral view) with concentric sculpture. First part of ninth segment synscleritous with a narrow anterior apodeme. Hypandrium short with two setae. Paramere distally with a large dorsal process, latter with a caudal and a lateral projection. A pair of moderately sclerotized ventral plates situated below parameres. Uncini strong with large outer, and short, hooked inner arm.

Remarks: The new species resembles *Semidalis obscura* SZIRÁKI et GRÈVE, 1996 (SZIRÁKI et GRÈVE 1996, figs 11–17) because of the ventral plates below the parameres, the paired, long setae on the hypandrium, the presence of male clasping foreleg, and of the setae on flagellar the segments. The main distinctive characteristics of *Semidalis tenuipennis* sp. n. are:

- clasping foreleg on the males with bent, spiny tibia (in *S. obscura* tibia of the male clasping foreleg is rather straight without strong spines);
- unusually narrow wings;
- characteristic paramere supported by paired ventral plate;
- well-developed uncini.

ZOOGEOGRAPHICAL REMARKS

A zoogeographical evaluation of the Yemenian coniopterygids will be published in separate paper (SZIRÁKI 1997), and in some respects it has already been done (MONSERRAT 1996). However, it is worth to mention that the coniopterygid assemblage of this country is equally close to that of the eremial part of the Palaearctic and of East Africa. On the other hand, the presence of the genus *Cryptoscenea* is extremely interesting, and it shows some connections with the fauna of the Indo-Malayan islands. In this connection the North Equatorial Current may have played a role.

* * *

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SPATIAL ARRANGEMENT OF ROOSTING GREAT TITS (PARUS MAJOR) IN A HUNGARIAN FOREST

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We studied the territoriality of the Great Tit (*Parus major*) in winter, on the basis of spatial arrangement of roosting birds. The study was conducted in a Central Hungarian swamp from 1988 to 1990. We developed a simulation model to analyse the spatial pattern (uniform, clumped or random) of roosting birds based on nearest-neighbour distances. This technique compares the observed nearest-neighbour distances with the expected values from random arrangement of the individuals. The results showed that random spatial pattern of roosting individuals was common. There may be biological reasons which caused the failure to show winter territoriality in the Great Tit: (1) the variations in wintering strategies (floaters, residents), (2) possible alliance among individuals, and (3) no territoriality in winter at all.

Key words: spatial pattern analysis, Great Tit (*Parus major*), nestbox area, wintering site fidelity

The Great Tit (*Parus major*) is one of the best studied bird in the world (e.g. GOSLER 1993), however, its winter roosting behaviour is relatively poorly known (BÁLDI & CSÖRGŐ 1994*a*). We know that there is strong interspecific competition for the roosting holes between the Great and the Blue Tits (*Parus caeruleus*) (DHONDT & EYCKERMAN 1980, KEMPENAERS & DHONDT 1991). There is a clear distinction between resident birds which regularly use nestboxes for roosting, and floaters which only occasionally roost in the holes (SCHMIDT *et al.* 1985, BÁLDI & CSÖRGŐ 1991). In an earlier investigation, we found strong area fidelity among the roosting individuals, the diameter of the area within which the nestboxes were used for roosting was 130–180 m, depending on sex and age (BÁLDI & CSÖRGŐ 1994*a*). The position of nestboxes used for breeding was usually in the centre of this area. That is, the pattern seems to be similar to that observed in the breeding season, when the nesting hole is usually in the centre of the territory (GIBB 1956, PERRINS 1979). In addition, about 60–80% of the nestboxes remained unoccupied, although many floater tits were captured in the area during daytime, which may indicate that the winter roosting area is defended against non-residents. Therefore we hypothesised that there should be some form of ter-

ritoriality in the winter. To test this hypothesis we analysed the spatial arrangement of the roosting individuals by spatial pattern analysis.

Spatial pattern analysis (SPA) evaluates the arrangement of individuals in any geographical area. There are three types of spatial patterns: uniform, random and aggregated (KREBS 1989). SPA is especially well developed for botanical investigations (e.g. GREIG-SMITH 1983), although some ornithological studies are also known (KREBS 1971, REVILLE 1988, 1991, JÄRVINEN 1992, MOSKÁT *et al.* 1992, HU & MOSKÁT 1994). Due to the vagility of birds, the analysis of their distribution needs a different approach than that used for plants. A possibility is to analyse the position of the nests, as a stable objects in space, but functionally related to the given individuals. The distribution of roosting sites may also give a good possibility to apply SPA.

The aims of this study are to analyse spatial arrangement of individually marked roosting Great Tits. Our questions were: (i) How do Great Tits distribute themselves into roosting sites? (ii) What is the influence of different age and sex on roosting site selection?

STUDY AREA AND METHODS

The study was conducted in the Ócsa Landscape Protection Area, about 30 km south of Budapest, Central Hungary (47°15'N, 19°15'E). There were various types of the swamp vegetation, marshes, reedbeds, bulrush stands, bushes and forests in the protected area. The study area was in a small (7 ha) alder forest (*Alnus glutinosa*). In the spring of 1986 100 nestboxes were spaced out in the forest, in the cross-sections of a 30×30 m grid (Fig. 1). All boxes were of the same type with an entrance diameter of 32 mm. Boxes in poor condition were replaced.

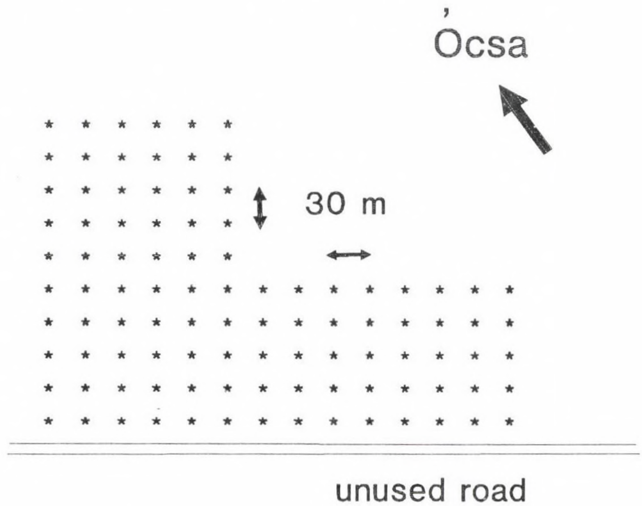


Fig. 1. Schematic map of the nestbox area and the arrangement of nestboxes within a 30×30 m grid

Diameter of tree trunks at breast height was about 15–25 cm. The surrounding of the nestbox area was a heterogeneous landscape consisting of mainly marshes, reed beds, and various willow bushes (*Salix alba*, *S. cinerea*, *S. caprea*). We assume that the number of natural holes were negligible.

The nestboxes were visited at night every other week between November and March from 1986/87 to 1989/90. We analysed all birds and resident birds, separately. For this analysis only data of 1988/89 and 1989/90 were used. All tits caught were ringed, and their age and sex were determined.

Method for SPA for all birds: We used the nearest-neighbour distance method (CLARK & EVANS 1954). CLARK and EVANS compared the expected random pattern with the observed pattern, based on nearest-neighbour distances. The index of aggregation, R, is 1 when random pattern occurs, in uniform pattern greater than 1, in clumped pattern smaller than 1 (KREBS 1989). However, the spatial arrangement of artificially provided nestboxes had already a uniform pattern, which was determined by the placement of the boxes. Therefore tits may select roosting sites randomly, but the results will suggest a uniform pattern (unless there are much more nestboxes than in our case). In our study area, where the nestboxes were spaced out in a uniform pattern, R could be greater than 1 even if roosting is random. We found by 120 simulation runs (see details below) that $R \cong 1.5$ for random nestbox occupancy of roosting tits in the "uniform space" provided by the nestboxes.

We analysed the spatial pattern of roosting tits for every night separately. To detect spatial arrangement of roosting tits in a given night, we applied a method based of that CLARK and EVANS (1954). The original procedure is based on the comparison of expected and observed nearest-neighbour distances. Although CLARK and EVANS published a formula for the calculation of expected nearest neighbour distances, due to the problems outlined above, we determined these distances by simulations. In this way we intended to avoid the problem arising from the regularity of nestbox arrangement. Twenty simulations were carried out for 5, 10, 15, 20, 27, and 40 numbers of individuals. The roosting site selection was determined by generating random integer numbers between 1 and 100, according to the number of nestboxes. Then the nearest-neighbour distances were calculated and a line was fitted to the points. If the observed distance proved to be smaller than the random value for a given number of individual, clumping occurred, and if the observed distance was

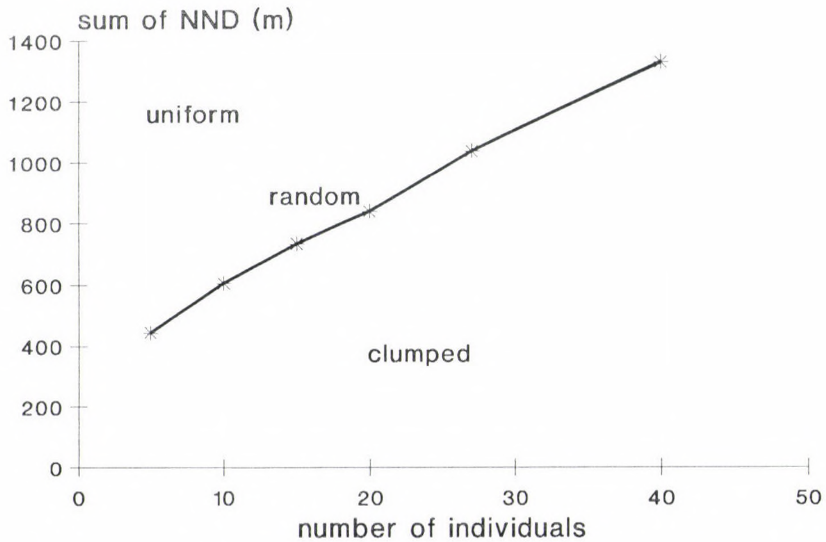


Fig. 2. Results of the simulation runs of the spatial pattern of the tits. According to this model, the observed nearest-neighbour distances (NND) can be classified as uniform, random, or clumped

greater, uniform pattern occurred. Figure 2 visualises the method. We used the statistics given by KREBS (1989) for determining significances. The expected values, which were based on the simulations were compared to the observed values using the statistics:

$$z = \frac{\frac{\sum r_i}{n} - \frac{1}{2\sqrt{p}}}{\frac{0.26136}{\sqrt{np}}}$$

where r_i = measured distances to nearest neighbour for individual i, p = density of individuals, and n is the number of individuals. The value of z at the 0.05 significance level is z = 1.96, for two-tailed significance.

The SPA was carried out for each checkings of the two winters, for all the Great Tits and for the resident tits separately. We considered a bird to be resident if it was recorded to roost in nestbox more than four times during the whole study (1986/87–1989/90). For the analysis of the distribution of all Great Tits and of the resident tits data were grouped as following: (1) adult males, (2) adult females, (3) immature males, and (4) immature females.

We investigated the effects of sex, age and residency status by analysis of variance (ANOVA), using aggregation index as the dependent variable.

RESULTS AND DISCUSSION

There were 832 records of roosting Great Tits during the study. Other species, the Blue Tit, Tree Sparrow (*Passer montanus*) and Nuthatch (*Sitta europaea*), were rarely recorded (BÁLDI & CSÖRGŐ 1994*a*). The majority of observations were recaptures of roosting individuals, only 11.8% were new records. Most of these were registered at the first night check of a given winter (November or December). These figures revealed that the majority of the roosting birds were resident Great Tits.

There were no clear results in the spacing among all birds roosting in the nestboxes (Table 1 and 2). Neither of the ANOVAs showed significant effect, even at the p = 0.1 significance level. Thus, random spatial arrangement of roosting individuals in different age and sex classes was common in the winter of 1988/89 and 1989/90.

The fidelity of Great Tits to a restricted area of ca. 150 m diameter in winter was shown in our previous study (BÁLDI & CSÖRGŐ 1994*a*). This may indicate a winter site fidelity, therefore in the present study we attempted to detect some form of winter territoriality by the analysis of spatial position of roosting individuals. In spite of the expectation, we detected mainly random distribution of the roosting individuals.

What should be the reason for the failure of detecting non-random patterns by the SPA? There are various wintering strategies in the Great Tit, from floaters

Table 1. Spatial pattern of the (A) whole and (B) resident roosting Great Tit population in the winter of 1988/89. The night checks were carried out every other weeks from November to the end of March. R: random; U: uniform; C: clumped pattern; -: omitted, less than 5 individuals (at $p<0.05$)

(A)	Checkings									
	1	2	3	4	5	6	7	8	9	10
adult male	R	R	R	R	R	R	R	R	R	–
adult female	R	C	R	C	U	R	R	U	R	U
immature male	R	C	U	R	R	R	U	R	R	R
immature female	–	–	–	–	–	–	–	–	–	–
(B)										
adult male	C	R	R	R	R	R	R	R	R	–
adult female	–	–	–	–	–	–	–	–	–	–
immature male	U	–	U	R	–	R	–	R	R	–
immature female	–	–	–	–	–	–	–	–	–	–

to territory owners (EKMAN 1989, MATTHYSEN 1990, BÁLDI & CSÖRGŐ 1991). In addition, we may suppose relationship among individuals, which may result in some form of co-operation, like alliance (EKMAN 1990, SWENSON 1993). Both the variations of wintering strategies, and of the supposed relationship among individuals may interact, with the result that the winter territoriality, if it exists at all, is almost undetectable at the population level.

Table 2. Spatial pattern of the (A) whole and (B) resident roosting Great Tit population in the winter of 1989/90. The night checks were carried out every other week from December to the end of March (the study started later than in 1988/89). (R: random; U: uniform; C: clumped pattern; –: omitted, less than 5 individuals (at $p<0.05$).

(A)	Checkings						
	1	2	3	4	5	6	7
adult male	R	R	R	R	R	R	R
adult female	R	R	R	C	–	R	R
immature male	R	R	R	R	C	R	R
immature female	R	R	R	R	–	R	R
(B)							
adult male	R	R	R	R	C	C	R
adult female	–	–	–	–	–	–	–
immature male	R	R	C	U	R	R	C
immature female	–	–	–	–	–	–	–

The supposed winter territoriality is markedly differ from the spring territoriality. In winter even the resident tits may leave their territories during daytime, sometimes they moved 800 m apart for feeding (pers. observation). In spring Great Tits leave their territory to a considerably smaller distance (YDENBERG 1984). This is in accordance with our observation that in winter Great Tits use nestboxes within ca. 150 m (BÁLDI & CSÖRGŐ 1994*a*), but in spring, their breeding area fidelity is only ca. 60 m (BÁLDI & CSÖRGŐ 1994*b*). These differences may indicate that in winter the defence of the area of the potential breeding territory is weak, but the large proportion of empty nestboxes in winter indicates strong defence of the holes. This pattern may be explained on a functional basis. In the breeding season territory may be maintained for food, for avoiding predators or for preventing extra pair copulations. In winter, however, survival depends mainly on weather conditions, even food supply is mediated by weather. Therefore the area is not defended. In spite of this, the nestboxes had significant role in winter for protection against weather, and it has a potential role in the future as breeding hole.

* * *

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TESTING EDGE EFFECT ON CARABID ASSEMBLAGES IN AN OAK-HORNBEAM FOREST

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The edge effect hypothesis was tested along a transect for carabid assemblages in an oak-hornbeam forest in Aggtelek National Park, Hungary using pitfall traps. The number of trapped individuals, species richness, and Shannon diversity increased significantly along the transect, and each of these characteristics was significantly higher at the forest edge than in the interior. *Carabus arcensis* HERBST, 1784, *Harpalus latus* (LINNAEUS, 1758), *Harpalus rufipes* (DE GEER, 1774), *Pterostichus strenuus* (PANZER, 1797) and *Abax parallelus* (DUFTSCHMID, 1812) appeared exclusively in the forest edge suggesting that it has a particular carabid assemblage with several edge-associated species. Correlation analyses proved that relative air moisture, percentage cover of the leaf litter, cover of herbs and shrubs and the cover of canopy layer are important factors determining the abundance, species richness and diversity of carabid assemblages along the transect. Our results suggest that in oak-hornbeam forests there is a significant edge effect on the carabids, and forest edges play a crucial role in the maintenance of diversity of carabid assemblages.

Key words: edge effect, carabid assemblages, forest edge, diversity

INTRODUCTION

An ecotone is a zone of transition between adjacent ecological systems, having a set of characteristics defined by space and time scales and by the strength of the interactions between the adjacent ecological systems. Thus, an ecotone is a system that can be interpreted at any hierarchical level, from population to the biosphere; at any extension, from a few centimeters to thousands of kilometers; according to the spatial and temporal scale of research. The forest edge is a type of ecotone which is interpreted at the meso-spatial scale and at the community level (HOLLAND *et al.* 1991, HANSEN and DI CASTRI 1992). In the forest edge there are abrupt changes in light regime, substrate, water conditions, species composition and other abiotic and biotic factors that generally characterise the edge. These factors are highly significant for small animals such as insects, especially ground-dwelling beetles (SAMWAYS 1994).

Monitoring of edges is also essential as these may react earlier to changes than the adjacent ecological systems and so includes early observation of structu-

ral changes, degradation and succession (HANSEN and DI CASTRI 1992). Such early observations may also contribute to the success of nature conservation.

Carabids are excellent subjects for studying the effect of changes in environmental conditions (NIEMELÄ *et al.* 1993), because their preferences for microsites (MÜLLER-MOTZFELD 1989, NIEMELÄ 1990), responses to soil type and microclimate (NIEMELÄ *et al.* 1992), and body size, physiology and behaviour vary considerably among species (THIELE 1977, DEN BOER 1986). Several authors have described the distribution and movement of carabid beetles in edgezones (BUREL 1989, PETIT and BUREL 1993, GRUTTKE 1994, PETIT 1994, ŠUSTEK 1994). Few of them, however, tried to measure the increase in species richness at habitat interfaces (BEDFORD and USHER 1994, BUTOVSKY 1994).

In this paper we tested the classical edge effect hypothesis. According to this hypothesis the abundance, species richness and diversity of carabids are expected to be higher in the forest edge than in the forest interior (LEOPOLD 1933). We studied the carabid assemblages in an oak-hornbeam forest along a transect. We also examined the environmental measurements that may be important for distribution of litter-dwelling carabids (NIEMELÄ and SPENCE 1994).

MATERIAL AND METHODS

Study area and sampling

The sampling area is located in Aggtelek National Park, North Hungary. It is located 5 km NE from the village of Jósvafő. The UTM code of the sampling area is DU67. It is a diverse part of the National Park, and is also the buffer zone of a Biosphere Reserve. In this region the most extensive typical native forest association is oak-hornbeam (*Querco petraeae–Carpinetum*). Two characteristic parts of a transect running rectangular to the forest edge were compared: (1) an oak-hornbeam forest interior, with relatively sparse ground-level vegetation, and (2) its forest edge, with dense herbaceous layer originating from the nearby grassy (*Polygalo majori-Brachypodietum pinnati*) area. The shrub layer was also dense in the forest edge, mainly consisting of shrubs and saplings of the canopy trees (*Carpinus betulus*, *Corylus avellana* and *Prunus spinosa*).

Beetles were sampled using unbaited pitfall traps made of plastic cups (diameter 100 mm, volume 500 ml), containing ethylene-glycol as a killing-preserving solution (SPENCE and NIEMELÄ 1994). Pitfall traps were placed along a transect. The transect method is currently widespread for the study of carabid assemblages of adjacent habitats (USHER *et al.* 1993, BEDFORD and USHER 1994). Altogether 60 pitfall traps were placed, each at every 0.5 m along the transect; 30 traps in both of the habitats. Pitfall traps 1–30 were placed in the forest interior, while traps 31–60 in the forest edge. Beetles were collected monthly from April to October in 1994, so that samples covered most of the snow-free season. Following the suggestions of NIEMELÄ *et al.* (1990), trapping was done for 2 weeks every months. All carabid beetles taken in pitfall traps were identified to species using standard keys (FREUDE *et al.* 1976).

To explore whether any of the environmental measurements could predict abundance, species richness and diversity of carabid assemblages, we studied six environmental variables: temperature, relative air moisture on the ground surface near the traps, percentage cover of the leaf litter, cover of the herbs and shrubs, and the cover of canopy layer in a rectangle of 0.5 m by 2 m size around each trap.

Data analyses

Based on continuous pitfall catches pooled over the whole activity period, a reliable quantitative measure of the sizes of carabid populations and of assemblage structure can be obtained (BAARS 1979*a*). Therefore, pooled samples were used for the numerical analysis. It also compensates the differences in the phenological dynamics, which does not mean structural differences in the composition of the carabid assemblages.

To test the edge effect on carabid assemblages, abundance, observed number of species and Shannon diversity (e.g. PIELOU 1975) were calculated per trap. Regression analysis was applied to demonstrate if there was an increase in the studied characteristics along the transect. Mann-Whitney U-test was used to assess differences in assemblage structure between the two habitats. Spearman rank correlation and multiple regression were applied to analyse the relationships between the carabid abundance, species richness, diversity and the studied environmental measurements (SOKAL and ROHLF 1981). Analyses were carried out by the SPSS-PC programme package.

RESULTS

A total of 1373 individuals belonging to 20 carabid species were collected in the pitfall traps (Table 1). There was a strong positive rank correlation between the abundance of a species and the number of traps from which it was recorded (Spearman r_s=0.9851, p<0.0001) (Table 1). The abundance categories were determine for the captured species. Three species found in more than 50 traps and represented by a mean value of more than 2 individuals per trap were designated as abundant forest generalists and abundant species. Two other species were captured in 20–30 traps with 0.5–1 individuals per trap, which can be mentioned as subdominant species. Two-thirds of the species were found in less than 15 traps and were represented by a mean catch of less than 0.3 individuals per trap. These species are rare and may prefer microsites with specific environmental conditions (Table 1).

The following species were recorded exclusively in the forest edge: *Carabus arcensis* HERBST, 1784, *Harpalus latus* (LINNAEUS, 1758), *Harpalus rufipes* (DE GEER, 1774), *Pterostichus strenuus* (PANZER, 1797), *Abax parallelus* (DUFTSCHMID, 1812). A few additional species were caught in a higher frequency in the forest edge than in the forest interior: *Carabus violaceus* LINNAEUS, 1758, *Pterostichus melanarius* (ILLIGER, 1798), *Abax carinatus* (DUFTSCHMID, 1812), *Abax ovalis* (DUFTSCHMID, 1812) and *Aptinus bombarda* (ILLIGER, 1800). Other species, like *Notiophilus biguttatus* (FABRICIUS, 1799) and *Platynus assimilis* (PAYKULL, 1790), showed a much lower frequency at the edge than in the interior site (Table 1).

There was a significant positive correlation detected between the number of trapped individuals and the location of pitfall traps along the transect (F=10.37, df=1,58, p<0.01, r=0.3894) (Fig. 1*a*). The number of captured individuals increased towards the forest edge. Significantly more beetles were collected in the forest edge than in the interior (Mann-Whitney U-test, U=204.5, p=0.0003). Re-

Table 1. Number of individuals of carabid species caught in two habitats and the number of traps where the species were captured

Species	Forest interior	Forest edge	Number of occupied traps
Carabus arcensis	0	14	10
Carabus convexus	2	5	7
Carabus coriaceus	2	2	4
Carabus hortensis	6	4	8
Carabus nemoralis	5	7	11
Carabus violaceus	1	8	8
Notiophilus biguttatus	1	0	1
Harpalus latus	0	1	1
Harpalus rufipes	0	1	1
Pterostichus burmeisteri	50	72	51
Pterostichus melanarius	1	6	6
Pterostichus oblongopunctatus	322	375	60
Pterostichus strenuus	0	1	1
Molops piceus	15	15	25
Abax carinatus	2	8	9
Abax ovalis	9	29	26
Abax parallelepipedus	145	229	60
Abax parallelus	0	10	7
Platynus assimilis	9	1	8
Aptinus bombarda	3	12	13
Total	573	800	

gression analysis showed a significant positive relationship between the carabid species richness and the location of pitfall traps (F=26.80, df=1,58, $p<0.01$, $r=0.5622$) (Fig. 1*b*). Mann-Whitney U-test proved that significantly more carabid species were captured at the edge than in the interior part of the forest (U=170.5, $p<0.0001$). A significant positive correlation was found between the Shannon diversity and the location of traps along the transect (F=23.85, df=1,58, $p<0.01$, $r=0.5398$) (Fig. 1*c*). Difference in Shannon diversity between the assemblages of the forest edge and the interior proved to be significant (Mann-Whitney U-test, U=198.0, $p<0.0001$).

Significant rank correlations were found between carabid individuals, species richness and diversity and some of the environmental variables (Table 2). There were significant positive rank correlations detected between the number of carabid individuals per trap and the following variables: relative air moisture,

Fig. 1. Relationship between the abundance (A), species richness (B), and Shannon diversity (C) of the studied carabid assemblages and the location of pitfall traps along the transect. Pitfall traps 1–30 were placed in the forest interior, while traps 31–60 in the forest edge

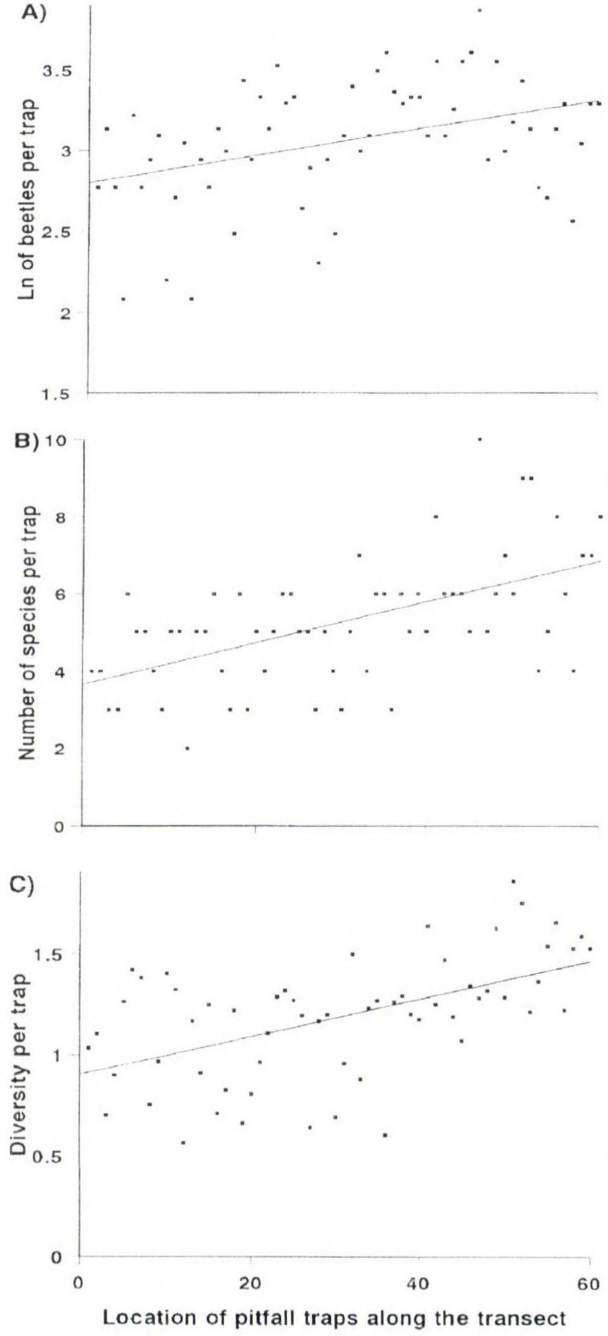


Table 2. Spearman rank correlation coefficients between carabid abundance, species richness, Shannon diversity and six environmental variables. Statistical significance: ns $p>0.05$, * $p<0.05$, ** $p<0.01$, *** $p<0.001$

Variables	Abundance	Species richness	Diversity
Temperature	0.1347 ns	-0.0595 ns	-0.1360 ns
Relative air moisture	0.3244*	0.4402***	0.4127**
Cover of the leaf litter	0.3949**	0.4588***	0.4126**
Herb cover (%)	0.3691**	0.5730***	0.5642***
Shrub cover (%)	0.3089*	0.5469***	0.5887***
Canopy cover (%)	-0.1844 ns	-0.3871**	-0.4618***

cover of leaf litter, cover of herbs and shrubs; while correlations between the number of individuals and two other variables (temperature, and cover of canopy layer) were not significant. The species richness per trap increased as relative air moisture, cover of leaf litter, cover of herbs and shrubs increased, and when relative canopy cover decreased. The other correlation was not significant (temperature). Shannon diversity per trap increased as relative air moisture, cover of the leaf litter, cover of the herbs and shrubs all increased, and as relative canopy cover decreased, while the other rank correlation was not significant (temperature).

By multiple correlation analysis we proved that there were significant positive correlation between the six measured environmental variables and the number of individuals (F=3.84, df=6,53, p=0.0030, r=0.5504), also for the number of species (F=4.57, df=6,53, p=0.0008, r=0.5839), and for the Shannon diversity (F=5.28, df=6,53, p=0.0003, r=0.6116). However, there were no significant correlations between the environmental variables separately, and the parameters of the assemblages (number of individuals, number of species, Shannon diversity).

DISCUSSION

The heterogeneity of ecological systems has become into focus recently. Their mosaic-like components differ in structure and dynamics (HOLLAND *et al.* 1991). The complexities of transitions between relatively homogeneous patches, and the interactions between such patches provide a challenging research problems. The relations between ecotones and biodiversity have traditionally caught the interest of ecologists, because ecotones may serve as either barriers or corridors between populations, and because they represent unique habitats favoured by some species, and an inhospitable to others. The edge zone may serve as a secondary habitat for species.

FUISZ and MOSKÁT (1992) stressed the importance of scaling because community parameters may change considerably. During the study the observed differences were significant for the traps analyzed singly and after pooling 2 and also 3 neighbouring traps.

Our study revealed a significant edge effect on the carabid assemblages. The number of carabid individuals, the number of species and diversity increased along the transect towards the forest edge (Fig. 1). We also proved that relative air moisture, the cover of the leaf litter, cover of herbs, shrubs and canopy layer are important factors determining the number of individuals, species richness and diversity of carabid assemblages along the transect (Table 2). Multiple regression analysis proved that the six studied environmental variables were significantly correlated with the assemblage parameters. However, it also pointed out that neither of the environmental variables can explain alone the changes of the assemblage parameters along the transect. It means that these environmental variables are strongly correlated and they boost each other's effect. It is also evident from the r^2 values of the multiple correlation analysis that these environmental factors explain only 30–40% of the total variation, therefore there are other important factors influencing the distribution of the carabid assemblage. Food and soil parameters may be mentioned as other relevant environmental factors (THEIELE 1977, LÖVEI and SUNDERLAND 1996). Similar observations have been reported in the literature; vegetation and its consequences to the microclimate are likely to be some of the most important factors structuring carabid assemblages (NIEMELÄ *et al.* 1992, 1996, VERSCHOOR and KREBS 1995, MAGURA *et al.* 1997). Greater heterogeneity of vegetation accompanied by higher diversity of the carabid assemblages (BÁLDI 1990, BEDFORD and USHER 1994, WALICZKY 1991). LIEBHERR and MAHON (1979), REFSETH (1980), PARMENTER and MACMAHON (1984) and NIEMELÄ *et al.* (1988, 1996) have also pointed out that the diversity of carabid assemblages was related to the heterogeneity of the habitat.

In the case of forest edge it can be stated that the deep leaf litter, the herbaceous vegetation from the nearby grassland (*Polygalo majori-Brachypodietum pinnati*) and the shrubs from the forest significantly contribute to the heterogeneity of the habitat and support the development of microhabitats. It was reported that with the increase of coverage of the vascular plants and shrubs the microclimatic conditions become more favourable for the majority of carabids and their egg and larval development (THIELE 1977). Furthermore, as all the trapped carabids are non-specialised predators or scavengers, percentage cover of the herbs and the shrubs may increase the amount of herbivorous invertebrate prey available for carabids and may provide a more uniform resource distribution in time (NIEMELÄ and SPENCE 1994, NIEMELÄ *et al.* 1996). Increased niche-specialisation, the smaller resource-overlap (PARMENTER and MACMAHON 1984) and the decreased intra- and interspecific competition through separate distribution of

beetles in the deep leaf litter (LOREAU 1987, 1988, MÜLLER 1987) may explain the high diversity value we observed at the edge.

The different habitats (the interior and edge of the forest) are not independent of each other at the studied local spatial scale, and the carabids can move easily between these adjacent habitats. Dispersal between habitat patches considerably influences species composition, diversity and the structure of carabid assemblages (NIEMELÄ 1988). There were significant negative correlations between species richness, diversity of carabids per trap and the canopy cover (Table 2). With decreasing canopy cover, species frequent in open habitats can also immigrate into the forest edge. In our study *Harpalus latus* (LINNAEUS, 1758) and *Harpalus rufipes* (DE GEER, 1774) may be mentioned as such species (Table 1). This local dispersal process increased the species richness and diversity at the edge (Fig. 1*b, c*). BÁLDI and KISBENEDEK (1994) also observed that *Harpalus rufipes* (DE GEER, 1774) showed positive edge preference.

The higher abundance, species richness and diversity at the forest edge may be caused by local dispersal processes, as carabid beetles are able to cover large distance while searching for food (BAARS 1979*b*, MAGURA 1995) and exhibit density-dependent migration (GRÜM 1971), aggregation (BRYAN and WRATTEN 1984) and movement between reproduction and hibernation habitats (WALLIN 1986). Migration greatly reduces the chances of extinction, emphasising the importance of movement between suitable patches. Edges with permeability appropriate for organisms operating on several scales (NIEMELÄ *et al.* 1993, 1994), and they can connect several populations (HANSEN and DI CASTRI 1992). Our research pointed out that the forest edges may play a crucial role in the maintenance and preservation of diversity, therefore their protection is essential.

* * *

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POST-EMBRYONIC DEVELOPMENT OF *LITHOBIUS VALIDUS* MEINERT (CHILOPODA: LITHOBIIDAE)

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Five larval (L) and 9 post-larval (PL) stadia have been identified in the post-embryonic development of *Lithobius validus* MEINERT, 1872 (Lithobiidae); specimens caught in nature in Slovenia, as well as those laboratory-reared, were studied. The changes in morphological character currently in use for species identification were followed during development. The characters distinguishing different stadia of the same species are described, as well as those by which the species are mutually distinguished.
The larval stadia of *L. validus* have a different number of legs and antennal articles, but there is only a small difference in body size, and no difference in the number of ocelli. The post-larval stadia are recognized by the number of coxal pores, ocelli, setae on the genital sternites and gonopods, forcipular teeth, body size and spinulation on legs.
Comparison of the same stadia reveals that the specimens of *L. validus* are larger than those of *L. forficatus* (LINNÉ). Both species are also distinguished by the number of antennal articles up to L3, teeth on the forcipular coxosternite up to L1, and the presence of posterior projections on tergites 6, 7 up to L3.

Key words: *Lithobius validus*, post-embryonic development, taxonomy

INTRODUCTION

Lithobius validus MEINERT 1872 is a common species in Central Europe (EASON 1974, KOREN 1992, KOS 1987, 1988, LOKSA 1979, MATIC 1966). In Slovenia it inhabits several types of forest communities from lowlands to highlands (KOS 1987, 1988, 1996). It can be particularly abundant under stones and loose bark (LOKSA 1979, KOS unpubl.). A high level of intraspecific mutual tolerance is exhibited between specimens in nature, as well as in the rearing dishes.

Lithobius validus is a species of the centipede order Lithobiomorpha, characterised by more than 2+2 teeth on the forcipular coxosternite and by a relatively large body. In this group in Central and Southeastern Europe similar species are: *L. forficatus* (LINNÉ), *L. validus*, *L. matici* PRUNESCU, *L. parietum* VERHOEFF, *L. piceus* L. KOCH, *L. dalmaticus* LATZEL, *L. peregrinus* LATZEL, and the species of the genus *Eupolybothrus*. Because of the incomplete taxonomic description particularly of the larval and the first five post-larval stadia, the identifi-

cation of these species has been impossible or uncertain. Up to now, only the post-embryonic development of *L. forficatus* has been described (ANDERSSON 1976).

A detailed description of the species and the variability of its characters has been given by EASON (1974) and by KOS (1987). The problem of incomplete knowledge of the variability of certain characters during the post-embryonic development has already been pointed out. Since some taxonomic characters of Lithobiomorpha change during post-embryonic development (ANDERSSON 1976, 1978*a, b*, 1979, 1981, 1984, FRÜND 1983, MINELLI *et al.* 1996, MURAKAMI 1958), the complete taxonomic description of a species must also include the relevant data.

For our further ecological studies, we needed to identify exactly the stadia of *L. validus*, their taxonomically different populations, and also similar species. It was necessary therefore first to study the morphological changes during the post-embryonic development of the species.

MATERIAL AND METHODS

The method for studying post-embryonic development follows that of ANDERSSON (1976, 1978*a, b*). Data were collected both from specimens reared in laboratory and from specimens collected in nature and preserved in 70% ethanol with 10% glycerol.

Development from the egg was monitored to the death of the animals. All the specimens of the studied egg-laying females in the laboratory, and the preserved specimens came from the same locality, i.e. a mixed forest near Ribnica, Slovenia.

The animals reared were observed once a week. Specimens in the moulting period were not included in the measurements. The measuring methods are described by KOS (1987). The characters observed were: number of legs, body length, head length and width, number of ocelli, number of antennal articles, number of forcipular teeth, posterior projections on tergites 6, 7, 9, 11, and 13, spinulation, number of coxal pores on the last four legs, number of setae on the ventral side of the first genital sternite, number of setae on the second genital sternite of males, and number of dorsolateral setae on the second article of the female gonopod.

The total number of animals observed was 210, distributed into larval (L) and post-larval (PL) stadia as follows: L0:26, L1:12, L2:18, L3:12, L4:16, PL1:16, PL2:14, PL3:18, PL4:15, PL5:18, PL6: 12, PL7:12, PL8:11, PL9:10.

RESULTS AND DISCUSSION

We found 5 larval and 9 post-larval moulting stadia by rearing *L. validus* from egg to death in the laboratory. The reared specimens of the ninth post-larval stadium were similar to the most developed specimens from nature, leading to the conclusion that *L. validus* also has nine post-larval stadia in nature. The stadium PL10, reported by BROLEMANN (1930) for *L. forficatus* from central Europe, was not found in *L. validus*.

Development of legs. The development of the legs in the larval stadia is identical to ANDERSSON's data for 8 spp. of *Lithobius* (ANDERSSON 1979). This is the best character for identification of larval stadia, and is also most useful for evaluation of other characters.

Body length. Body length is not a reliable character and is also difficult to measure. Because of the soft intersegmental membrane, body length depends on the condition of muscles in life and after fixation. Body length was, nevertheless, measured for comparison with existing descriptions of this and other species (ANDERSSON 1976, 1978*a*, EASON 1974, KOS 1987, MATIC 1966).

No growth was observed between stadia L0 and L1. The variation in body length is very high, particularly from stadia PL2 (Fig. 1). The maximum length in the last stadium is 39 mm, a value higher than reported by KOS (1987).

A comparison of the same stadia in Fig. 1 with those of ANDERSSON's Fig. 1 (ANDERSSON 1976), revealed that the specimens of *L. validus* are larger than *L. forficatus* from Sweden.

Body length may be used only cautiously, and in combination with other characters, for identification of the developmental stadia or for species identification.

Head length and head width. Because of the strong head capsule, head length or width is much more reliable than body length. During post-embryonic development, the head grows, as shown in Figs 2 and 3.

Like the entire body, the head of *L. validus* is also larger than the head of *L. forficatus* in comparison with ANDERSSON's figure (1976).

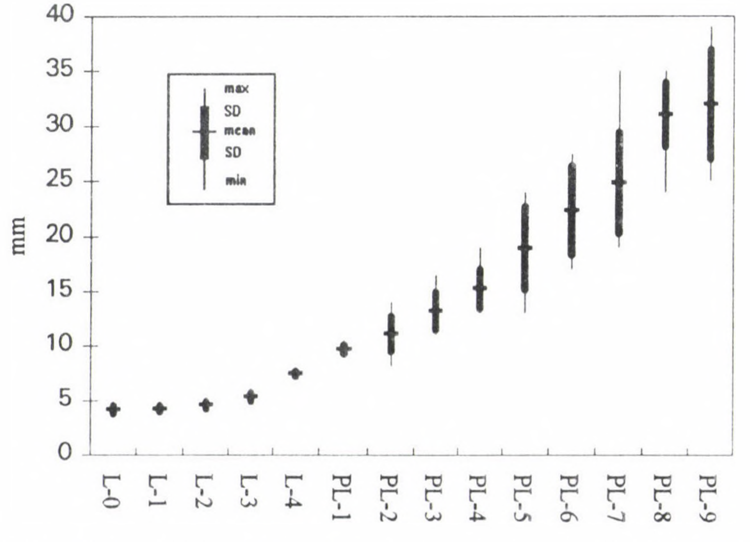


Fig. 1. Body-length in the different post-embryonic stadia of *Lithobius validus* MEINERT

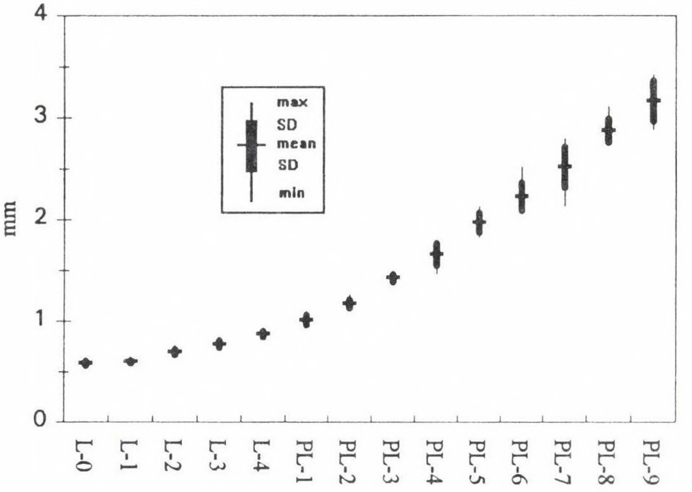


Fig. 2. Head length in the different post-embryonic stadia of *Lithobius validus* MEINERT

Head length and width are also characters which can be used only in combination with other ones for the stadium and species identifications. The variability of the head length and width of some post-embryonic stadia is greater than the difference in these characters between consequent stadia (Figs 2, 3).

Teeth on forcipular coxosternite. In stadium L0, the forcipular coxosternite is not yet distinctly denticulated. The initial 4+4 teeth develop in L1. The number of forcipular teeth increases with moultings, as presented in Table 1. The growth

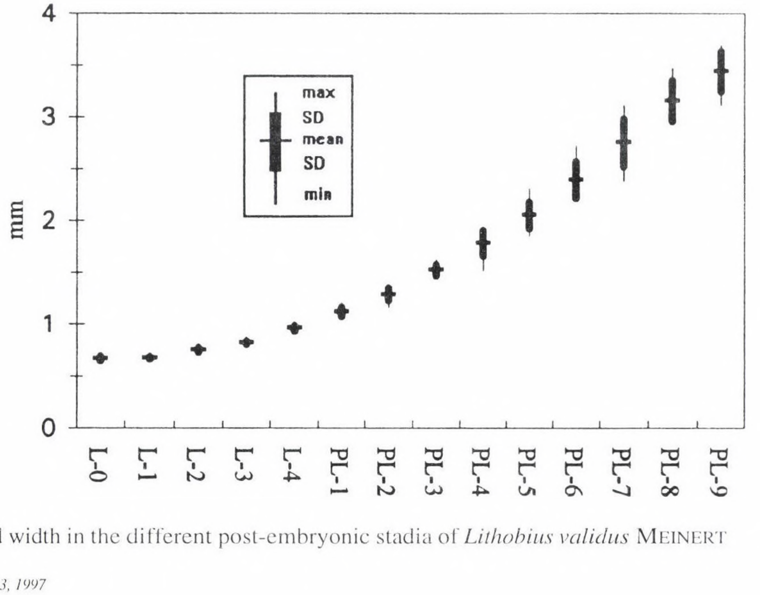


Fig. 3. Head width in the different post-embryonic stadia of *Lithobius validus* MEINERT

Table 1. Relative number of specimens (%) with different number of teeth on the coxosternite of forcipular segment in the different post-embryonic stadia of *Lithobius validus* MEINERT

teeth	L1	L2	L3	L4	PL1	PL2	PL3	PL4	PL5	PL6	PL7	PL8	PL9
4+4	100	100	80	22	17								
4+5			20	11		13							
5+5				67	75	81	55	15.5	11				
5+6						6	5	15.5	11		9	8	
5+7										11			
6+6					8		40	69	67	78	64	34	12.5
6+7									11			8	25
7+7										11	27	50	62.5

is irregular and variable, therefore the number of forcipular teeth is not a reliable character for the identification of stadia.

On the basis of this character, *L. validus* can easily be distinguished from most other species in Europe, since they have 2+2 forcipular teeth. The combination 4+4 in L1 is higher than that given by ANDERSSON (1976, 1979) for *L. forficatus*. The number of forcipular teeth also remains higher in older stadia of this species.

The number and the shape of forcipular teeth should be used for distinguishing between *L. validus* and different species of the genus *Eupolybothrus* from the Balkan. *Eupolybothrus* has a higher number of smaller forcipular teeth (see in MATIC 1966).

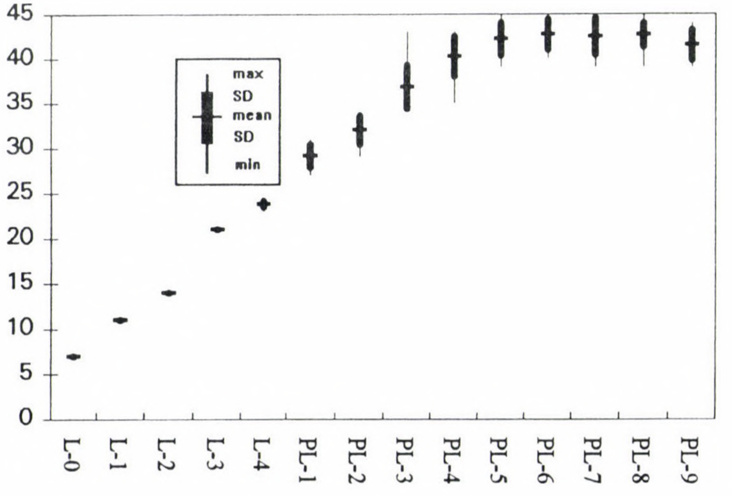


Fig. 4. Variation in the number of antennal articles of the left antenna in the different post-embryonic stadia of *Lithobius validus* MEINERT

Antennae. Only specimens with normal or completely regenerated antennae were used. There was no difference in the number of antennal articles between the left and right antennae, or between males and females.

The number of antennal articles increased from L0 to PL5, as shown in Fig. 4. This serves as a good distinguishing mark for stadia between L0 and PL4. The maximum number of antennal articles in some specimens collected in other localities in Slovenia is higher than in the specimens near Ribnica.

The number of antennal articles in L0 to L2 is equal in *L. validus* and *L. forficatus*. In L3 and other later stadia the number of antennal articles is higher in *L. validus*; Consequently, this reliable taxonomic character may be used to distinguish among these similar species. If we exclude the damaged antennae, and if we know the variation in this character, we can use this character for comparison between different populations.

Ocelli. The variation in the number of ocelli during post-embryonic development is shown in Fig. 5. The stadia L0, L1, L2 and L3 always have 2 ocelli on each side. In the later stadia, the number of ocelli increases and becomes very variable. We found between 21 and 34 ocelli in both of the last two stadia without any differences between them (Fig. 5).

Projections on tergites 6, 7, 9, 11, 13 and 15. L. validus has broad, lobate projections on the posterior margins of tergites 6, 7 and more prominent projections on tergites 9, 11 and 13 (see KOS 1987). L2 has a lobate posterior projection on tergite 6, L3 has projections on tergites 6, 7, 9, L4 on tergites 6, 7, 9, 11, and PL1 on tergites 6, 7, 9, 11, 13. The significant difference between males and females in the shape of tergite 15 develops in stadium PL2.

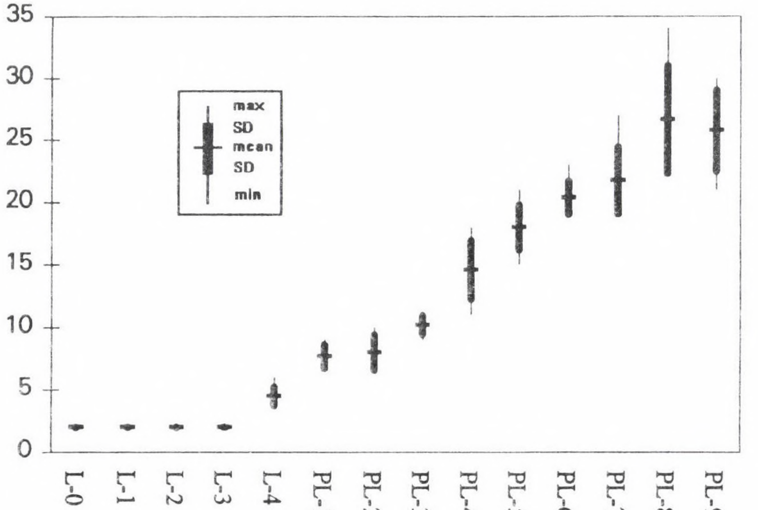


Fig. 5. Number of ocelli in the different post-embryonic stadia of *Lithobius validus* MEINERT

Posterior projections on tergites 6 and 7 are developed in L3. Therefore *L. validus* can be distinguished from the similar species *L. forficatus*, which is without posterior projections. The shape of the tergites is also an important distinguishing character between other sympatric species having more than 2 +2 teeth on the forcipular coxosternite, such as: *L. dalmaticus, L. matici, L. parietum, L. piceus, L. peregrinus* and some species of *Eupolybothrus*.

Spinulation. Spinulation of the legs is commonly used as a taxonomic character; therefore data about its development is particularly important. During post-embryonic development, the pattern of spinulation changes, as shown in Table 2. Spinulation of the 15th legs in stadium PL1 is characterized by having only medial spines on the ventral and dorsal side of some articles of the legs.

Table 2. Combinations of spinulation of the last pair of legs in the different post-larval stadia of *Lithobius validus* MEIN. (Cx = coxa, Tr = trochanter, Pf = prefemur, F = femur, Ti =tibia; D = dorsal side, V = ventral side; A = anterior, M = medial, P = posterior spines; spines present only on one leg are labelled with small letters)

		Normally (62–100%)					Occasionally (37–11%)					Seldom (9–1%)				
		Cx	Tr	Pf	F	Ti	Cx	Tr	Pf	F	Ti	Cx	Tr	Pf	F	Ti
L4	D	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	V	–	–	M	M	–	–	–	M	M	M	–	–	–	–	–
PL1	D	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	V	–	–	M	M	M	–	–	M	M	–	–	–	–	–	–
PL2	D	A	–	AMP	P	–	–	–	AMP	P	–	–	–	MP	P	–
	V	–	M	AMP	AMP	M	–	M	AMP	AMp	M	–	–	–	–	–
PL3	D	A	–	AMP	P	–	A	–	AMP	P	p	–	–	–	–	–
	V	–	M	AMP	AMP	M	–	M	AMP	AMP	M	–	M	AMP	AMP	aM
PL4	D	A	–	AMP	P	–	A	–	AMP	P	p	–	–	–	–	–
	V	–	M	AMP	AMP	AM	–	M	AMP	AMP	M	–	–	–	–	–
PL5	D	A	–	AMP	P	–	A	–	AMP	P	p	–	–	–	–	–
	V	–	M	AMP	AMP	AM	–	M	AMP	AMP	M	–	–	–	–	–
PL6	D	A		AMP	P	–	A	–	AMP	P	p	–	–	–	–	–
	V	–	M	AMP	AMP	AM	–	M	AMP	AMP	aM	–	M	AMP	AMP	M
PL7	D	A	–	AMP	P	–	A	–	AMP	P	P	A	–	AMP	aP	P
	V	–	M	AMP	AMP	AM	–	M	AMP	AMP	aM	–	M	AMP	AMP	M
PL8	D	A	–	AMP	P	–	A	–	AMP	P	P	A	–	AMP	P	p
	V	–	M	AMP	AMP	AM	–	M	AMP	AMP	aM	–	M	AMP	AMP	M
PL9	D	A	–	AMP	P	–	A	–	AMP	P	p	–	–	–	–	–
	V	–	M	AMP	AMP	AM	–	M	AMP	AMP	AM	–	–	MP	AMP	M

Spinulation of *L. validus* is very similar to *L. forficatus* (ANDERSSON 1976), and is, therefore, not an adequate character for distinguishing between these two species.

Accessory apical claw on the 15th pair of legs. An accessory apical claw on the metatarsus of the last pair of legs was absent in all specimens studied.

Coxal pores. The number of coxal pores increases in post-embryonic development from PL1 to PL9. The increase is regular from PL1 to PL5: one new pore is developed in each coxa in every following stadium. After PL5, the development becomes irregular, which results in a variation in the number of pores. On the basis of the total number, it is still possible to distinguish between different later post-larval stadia (Fig. 6).

Genital sternites and gonopods. In PL1, sex cannot yet be recognized. The first genital sternite has no setae, and none of the visible gonopodes which develop in PL2.

Females. Gonopodes become evident in PL2 when they are still devoid of setae. In PL3, the gonopodes are already well-developed, and one spur is usually indicated. On the first genital sternite (GS 1) there are usually two setae, whereas gonopods lack setae. In PL4, one spur is developed and a new spur is indicated, and there are 8–12 setae on GS 1. Females of PL5 have 24–36 setae on GS 1 and two unequally developed spurs are present. PL6 has 44–56 setae on GS 1 and 8–11 dorsolateral setae on the second gonopod article. In later development, the number of setae on all parts of the last article increases, so that in PL7 there are about 88 setae on GS 1 and 14 dorsolateral setae on the second gonopod article. PL8 and PL9 have a number of setae similar to that of PL7, 72–124.

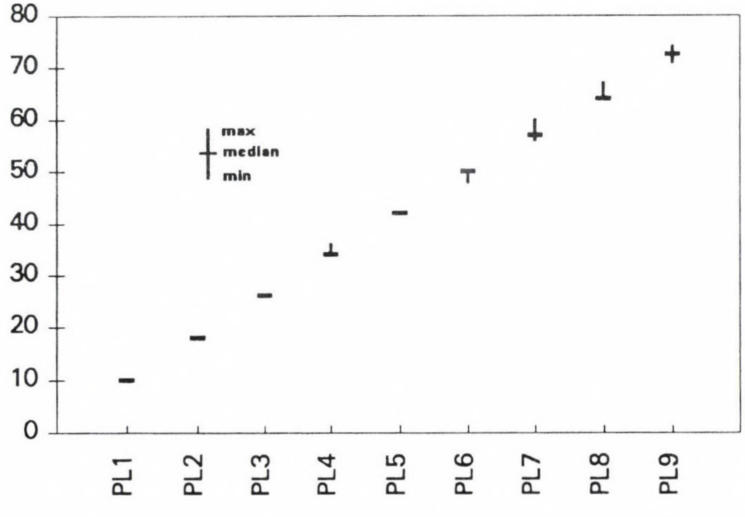


Fig. 6. Post-larval development of coxal pores on last four coxa in the different stadia of *Lithobius validus* MEINERT

Males. In PL2, gonopods cannot yet be recognized, and are without setae on GS 1. In PL3, they are still not evident; on GS 1 there are 4–6 setae. There are 14–18 setae on GS 1 in PL4; 17–56 setae in PL5; 28–60 setae in PL6; and 36–72 setae in PL7; PL8 and PL9 have 68–90 setae on GS 1. On GS 2 there appear two setae in PL5. One male (PL8) had 4 setae on GS 2.

The number of setae is a good additional character for the identification of the stadia, especially in early development, from PL1 to PL6.

CONCLUSIONS

Lithobius validus MEINERT from Central Europe has 5 larval and 9 post-larval stadia. These were determined by observations of reared and preserved animals.

The growth of the body and of the head begins after L1. The dimensions of the body and of the head are characters that can be used for identification of stadia only in combination with others. But they are more useful for distinguishing between *L. validus* and *L. forficatus* in larval and early post-larval stadia.

The number of ocelli is constant in the first four larval stadia with 2 ocelli on each side; thereafter, they grow irregularly, and their number becomes highly variable in the last two stadia.

There is no asymmetry in the number of antennal articles. Likewise, there is no variation in stadia younger than L3, so this feature is a good character for distinguishing between L0 and PL1. This character can also be used to distinguish between *L. validus* and *L. forficatus*, since – in stadia older than L2 – *L. validus* has more antennal articles than *L. forficatus*.

The posterior projections on tergites 6 and 7 develop in L2, while the characteristic shape of the male tergite 15 develops in PL2.

Coxal pores are a good character for identification of the post-larval stadia of *L. validus*. In stadia younger than PL8, a new pore develops on each coxa at each moult, so that the number of pores on coxa 13 and 14 corresponds to the number of the stadium.

* * *

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REVISION OF THE CLEPTES (HOLCOCLEPTES) SPECIES OF THE WORLD (HYMENOPTERA, CHRYSIDIDAE)

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One species, *Cleptes ignidorsum* sp. n. ♂ (from Russia) and the previously unknown males of *Cleptes radoszkowskii* RADOSZKOWSKI and *C. sjoestedti* HAMMER are described. The following types are designated: neotype for *C. sjoestedti* HAMMER; lectotype ♀, paralectotype ♀, and also additional syntypes (2 ♂♂) as paralectotypes ♂ in *C. radoszkowskii* RADOSZKOWSKI. The original specimens designated as ♂ paralectotypes of *Cleptes radoszkowskii* RADOSZKOWSKI belong to *C. femoralis* MOCSÁRY. *Cleptes pinicola* LIN is a synomyn of *C. sjoestedti* HAMMER. *Cleptes flammifer* SEMENOW is a subspecies of *C. radoszkowskii.* The subgenera *Holcocleptes*, *Leiocleptes*, *Chrysocleptes* and *Oxycleptes* are reinstated as a valid subgenera. A key for the 14 taxa of *Cleptes (Holcocleptes)* of the world is presented. The lectotype *C. aerosus* FÖRSTER ♂ is corrected to holotype. New taxonomic, distribution data and variability are given for *C. aerosus* FÖRSTER, *C. fudzi* TSUNEKI, *C. moczari* LINSENMAIER, *C. seoulensis* TSUNEKI and *C. sjoestedti* HAMMER.

Key words: taxonomy, distributions of subgenus *Holcocleptes*, Hymenoptera, Chysididae, Cleptinae

INTRODUCTION

The *Cleptes* species occurring mainly in Europe and North America were divided into seven subgenera by MÓCZÁR (1962). KIMSEY (1981) described a new subgenus *Neocleptes* from Argentina. BOHART and KIMSEY (1982) extended these subgenera to further American species.

After re-examination of *Cleptes* on a world basis, KIMSEY and BOHART (1991) synonymized the previous subgenera and divided *Cleptes* into species groups. During a revision of the *nitidulus* group (MÓCZÁR 1997) it appeared that some species did not correspond to the characteristics of either the *nitidulus* or the *satoi* species groups. The variety of most *Cleptes* species, especially the *orientalis* group, necessitated a study of all species of KIMSEY's species groups. I believe that only a revised and less divided subgeneric arrangement makes possible a better overview of the whole *Cleptes* species of the world. This new arrangement should be based on the external anatomical characters and only secondly on the colour of the available type material. A study of a dozen holotypes from Europe, East Asia, Japan and from the Oriental Region made it possible to reinstate from synonymic status the subgenera *Holcocleptes, Leiocleptes, Chrysocleptes* and *Oxycleptes*.

The detailed data of the type materials and the corrections of the earlier literature are given. Only those references are included in this paper, which contain descriptions of the type material or new observations, and new synonyms owing to the detailed work of KIMSEY and BOHART (1991).

Acronyms for museums, universities and institutions are as follows: CNC = Agriculture and Agri-Food Canada, Research Branch (former Canadian National Collection), Ottawa, Canada; HNHM – Department of Zoology, Hungarian Natural History Museum, Budapest, Hungary; ISK – Institute of Systematics and Evolution of Animals, Polish Academy of Sciences, Krakow, Poland; CL – Collection of Dr. W. LINSENMAIER, Luzern, Switzerland; NMW – Naturhistorisches Museum, Zoologische Abteilung, Wien, Austria; NRS – Naturhistoriska Riksmuseet, Sekcionen för entomologi, Stockholm, Sweden; OMNH – Osaka Museum of Natural History, Osaka, Japan; TARI – Taiwan Agricultural Research Institute, Insect Collection, Wufeng, Taichung, Republic of China; USNM – U.S. National Museum of Natural History, Washington D.C., USA; ZIP – Zoological Institute, Russian Academy of Sciences, St. Petersburg, Russia; ZMB – Museum für Naturkunde der Humbolt Universität (formerly Zoologisches Museum), Berlin, Germany.

Symbols: F-I (–II–III) = flagellomere I (and II, III); MS = malar-space (MS measured across the narrowest interval between the ventral eye margin and the ventral edge of malar space, within the two mandibular insertion); MOD = middle ocellus diameter; POL = postocellar line: OOL = ocellus–ocular line, the distance between oculus and the hind ocellus; Ped = pedicellus (measured in its whole length also with base, bending resembling a knee); PD = puncture diameter; T–I the first segment etc.

Subgenus *Holcocleptes* MÓCZÁR

Cleptes (Holcocleptes) MÓCZÁR, 1962: 118. Type-species: *Cleptes aerosus* FÖRSTER, 1853. Monobasic and orig. desig.

Pronotum with a transverse row of pits or foveae in front and before posterior margin and with a longitudinal sulcus along mid-line between two pit rows. Rarely this latter developed moderately or not for the whole length. Body usually with dense, partly with coarse punctures, terga sometimes partly finer punctured. Terga IV and in most cases also T–III double punctured. At most T–I with a low, rather sharp, hardly protruding and yellowish brown-coloured torus between dorsal and ventral sides. Lateral margin of all remaining abdominal segments between terga and sterna always rounded. Head, thorax and abdomen partly with different metallic colour or sometimes nearly concolorous, exceptionally whole thorax, including propodeum also with same colour; abdominal segments never greenish-red, flame red or coppery. Male genitalia: *C. aerosus* FÖRSTER (MÓCZÁR 1951: 271, Figs 15, 16).

The 14 taxa of the subgenus *Holcocleptes* occur in warmer parts of the Palaearctic and in the Oriental Regions. The type material of one of the species was not accessible.

CHECKLIST OF SPECIES

aerosus group

aerosus FÖRSTER, 1853 – Southern parts of Central and South Europe, Oran, Georgia
aerosus franciscae LINSENMAIER, 1987 – Morocco
collaris LINSENMAIER, 1959 – Turkey
ignidorsum **sp. n.** – Russia
libanoticus LINSENMAIER, 1959 – Lebanon
mandsuricus MÓCZÁR, 1968 – China
moczari LINSENMAIER, 1968 – Greece
radoszkowskii RADOSZKOWSKI, 1889 – Russia
radoszkowskii flammifer SEMENOW, 1891 **stat. nov.**

juengeri group

juengeri LINSENMAIER, 1994 – Spain

fudzi group

dipriovola TSUNEKI, 1982 – Thailand
fudzi TSUNEKI, 1952 – Japan
seoulensis TSUNEKI, 1959 – Korea
sjoestedti HAMMER, 1950 (= *pinicola* LIN, 1959) – China, Taiwan, Korea

KEY TO SPECIES

1 Postscutellum oblong (Fig. 2), distinctly wider than long or quadrangular. Posterior row of pits on pronotum usually moderately developed. Body with different lighter, often with bright metallic colour 2

– Lateral side of postscutellum strongly converging backwards, isosceles-, or equilateral-triangle formed with one unusually large and deep pit in front (Figs 7, 11). Posterior row of pits on pronotum well-developed. Body nearly dark, with green, blue, violet-purple or bronze-mixed coloured metallic highlights, reflections or tints (*fudzi* group) 11

2 T–I with very fine, T–II with denser, T–III with mostly closely punctures mainly anteriorly. Head, thorax with distinctly deeper, partly with rugulose or double punctures. Propodeal spine with strong thorn-like basis. Abdomen largely black with malachite green or rarely dark bluish reflection and with some dark brownish spots (*juengeri* group). Head, thorax including propo-

deum nearly entirely, fore and middle femora above flame red, partly with coppery tints. Hind femora black. Pronotum with golden reflection. Tegulae dark bluish. Postscutellum not reaching the scutellum, without a pit in front medially. 6.5 mm *juengeri* LINSENMAIER

– Body, particularly the abdomen dense, usually rather deep coarsely punctate, T–III–IV often with double punctures. Colour never malachite green, propodeum at most exceptionally reddish in the middle, terga usually yellowish or brownish red in front or largely black, sometimes partly metallic posteriorly. Head, thorax with strikingly metallic reddish, greenish or violet highlights. Postscutellum not reaching the scutellum, there are usually a deep, minute fovea row between those segments (*aerosus* group) 3

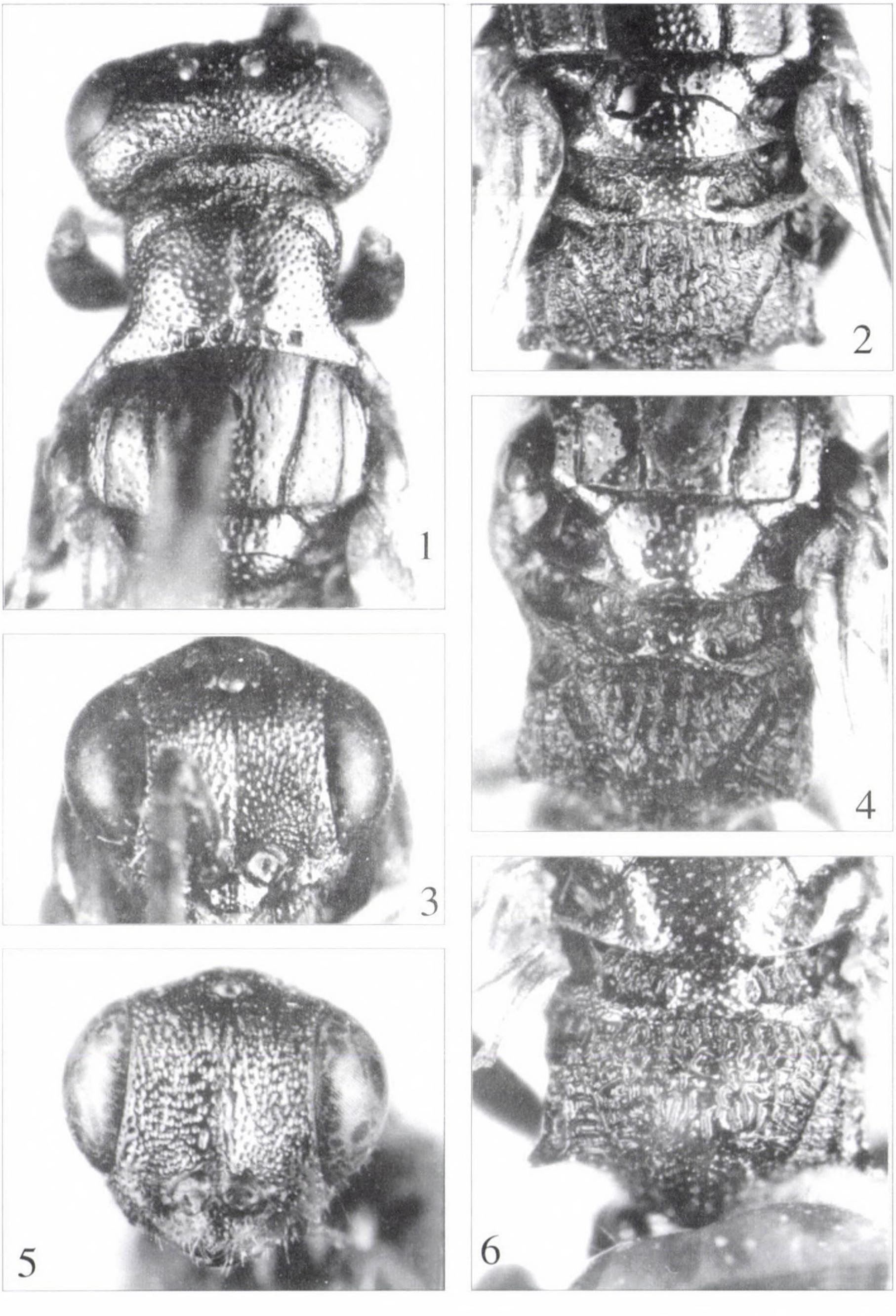
3 Abdomen nearly entirely black 4

– T I–II entirely, T–III largely or T–III–IV laterally yellowish red coloured, only last segments black 5

4 Two pits close to hind ocelli imperfectly connected with a swallow line incompletely connected with each other. Pronotum longitudinally without a distinct sulcus, only a shallow depression developed with indistinct punctures in the middle. Abdomen shining black, T–V and lateral sides of T–IV with pale blue tints; T–I and lateral part of T–II with yellowish brown spots. Bluish green, propodeum and femora metallic blue with violet reflection. Tibiae brown, except the yellowish brown fore tibia. Head closely, thorax finely punctured, pronotum with somewhat with coarser punctures. Abdomen with more distinct, T–II–III with less scattered T–III–IV with partly double punctures. T–I very fine, scattered punctures only on disc medially. 6.5 mm *libanoticus* LINSENMAIER ♂

– Two pits close to hind ocelli connected with a deep, very narrow sulcus with each other. Longitudinal sulcus of pronotum distinctly developed only in posterior half medially. Abdomen entirely black, only T–I basally, laterally and along posterior margin somewhat brownish red. Pronotum, mesonotum and propodeum medially flame red, rest of propodeum greenish blue and violet basally in the middle. Mesopleuron golden green. Femora and each tibiae green or greenish blue outside. Head black, vertex pale reddish medially, and coppery red laterally. 5.5 mm. *aerosus franciscae* LINSENMAIER ♀

Figs 1–6. 1–3: *Cleptes ignidorsum* sp. n. male: 1= head, pronotum and mesonotum; 2= scutellum, postscutellum and propodeum; 3= head, front view. 4–6= *C. radoszkowskii*, 4= thorax, male, 5= head front view, 6 = scutellum-propodeum, female



5 Vertex rarely partly, pronotum and mesonotum largely, often also scutellum flame red or greenish golden. Upper margin on the longer and posterior part of hind femora usually with a lighter or darker brownish line 6

– Head and thorax largely violet, partly with blue reflections, never flame red 9

6 Hind tibiae outside with metallic bluish green reflection. Lateral spine of propodeum pointed with thornlike or smaller base, margins of disc more or less divergent backwards. Postscutellum oblong partly with parallel lateral margins and with normal pit medially. T–I usually with dense punctures. Pronotum evenly slightly curved in lateral view. 7

– Hind tibiae brownish without metallic reflection. Lateral angles of propodeum right angled, hardly protruding without (Fig. 4) or exceptionally (♀) with a pointed spine (Fig. 6), margins of disc parallel. Lateral margins of postscutellum convergent basally (Fig. 6) and with larger pits in front 8

7 Lateral spine of propodeum larger, with thornlike basis and more pointed apex, lateral margin of disc more (♀) or less (♂) divergent backwards. The pits-row of pronotum posteriorly and the longitudinal mid-line differently developed, always with smaller pits or often narrow and shallow. Postscutellum green (♂), or partly with pale golden tints (♀). Tegula brownish translucent entirely with violet reflection (♂) and/or rarely with greenish tints (♀). Nervulus distincty antefurcal. Propodeum blackish violet (♂). Body often with golden (♀), greenish (♂) reflection or extended green. Face, head closely (♀) or coarsely punctured, largely or medially black, then partly green (♀). 6–7 mm. *aerosus* FÖRSTER

– Lateral spine of propodeum shorter, stumpy and with smaller base, with rounded apex (Fig. 2), lateral margins of disc parallel. About six remarkably large pits on pronotum medially well-outlined; longitudinal sulcus deep (Fig. 1). Postscutellum golden. Tegula with green reflection in front and brownish translucent backwards. Nervulus interstitial. Propodeum greenish blue **ignidorsum** sp. n. ♂

8 ♀ – Vertex with a black spot among and partly below ocelli. Propodeal angles pointed (Fig. 6). Posterior margin of pronotum black medially, with distinct pits-row. Postscutellum golden with a normal pit in front medially. Between the hind ocelli there is a small pit and on both sides a hardly perceptible shallow sulcus towards ocelli. Mesonotum with deep, T–I–II with close or very dense punctures, with 0–1 PD apart. 6.5 mm.

♂ – Vertex flame red, without black spot. Propodeal angles right angled (Fig. 4). Posterior margin of pronotum medially green, depressed and smooth, the pits row hardly distinct above it, lateral lobe convex, not depressed. Pronotum with coarser punctures. Postscutellum green with an unusually large pit medially. Between hind ocelli there is only a pit. T–I with fine and scattered, T–II with very dense punctures. 5.6 mm

radoszkowskii RADOSZKOWSKI

– Frons, vertex, pronotum, mesonotum and scutellum bright reddish or purplish gold. Propodeal angles posteriorly directed outwards, protruding apex hardly pointed. Pronotum not black medially with pits-row posteriorly; disc convex, longitudinal sulcus strongly impressed medially. Postscutellum greenish gold without a pit in front medially. Posterior ocelli connected by a deep transversal sulcus. F-I nearly twice as long as wide. Mesonotum, scutellum finely punctured. 6 mm. (According to SEMENOW)

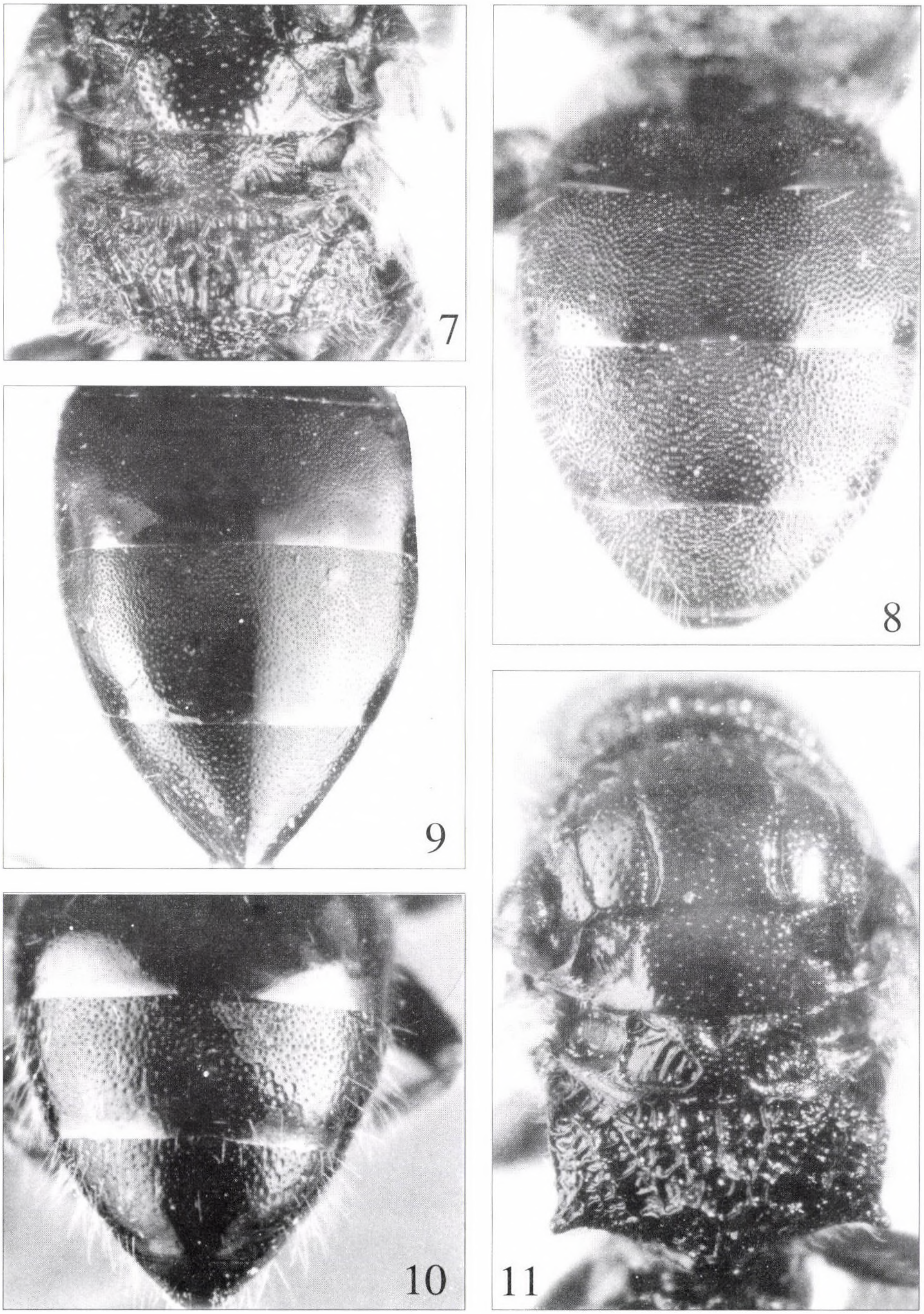
radoszkowskii flammifer SEMENOW ♀

9 Terga without metallic reflection or tints. Head and thorax largely violet partly with blue reflection. Disc of T–I with dense and deep punctures 0–3 PD apart, ♀ ♂. Frontal sulcus perceptible at most immediately below fore ocellus. Head and thorax nearly entirely violet, with greenish blue reflection or partly green. Postscutellar disc remarkably wider than long, with a deep pit medially in front and anterior margin becoming gradually deeper in a minute and long row of foveae, posterior margin straight, without foveae. Pronotal mid-line developed nearly on its whole length. T–II, T–III closely punctured, 0–2 PD apart and without (♀) or with some larger punctures (♂). ♀ 5.2–6, ♂ 4.6–5.8 mm *moczari* LINSENMAIER

– Last terga with violet or bluish green metallic reflection. Disc of T–I shining, at most denser punctured on posterior third. Head and thorax greenish blue with violet or green reflection. 10

10 Pronotal mid-line narrow on its whole length (Fig. 12). Lateral angles of propodeum with thornlike bases and directed obliquely (Fig. 13). Anterior margin of postscutellum with a large, deep pit medially. Pronotal punctures scattered posteriorly and denser in front (Fig. 12). Face with dense, partly close punctures. Tibiae bluish with violet reflection, tarsi brown. T–I and T–II except the triangular black spot medially, as well as lateral spots on T–III yellowish brown coloured. T–III–IV black with violet highlights, lateral margin and T–V dark blue. Head and thorax bluish green with violet reflection. Scape and pedicel partly metallic green. Propodeal disc black medially. 7.5 mm *mandsuricus* MÓCZÁR ♂

Figs 7–11. 7–8: *Cleptes dipriovola*: 7= scutellum-propodeum, 8= abdomen, male. 9–10. Abdomen: 9 = *C. seoulensis*, 10= *C. fudzi*, 11= *C. sjoestedti* thorax



– Pronotum with a sharp narrow longitudinal sulcus anteriorly, which become indistinct posteriorly; posterior margin with a sharply outlined pits-row. Propodeal teeth laterally slightly lengthened, directed greatly outward and not pointed apically. Punctures of pronotum rather strong, deep and partly wrinkled; mesonotum less strongly, scutellum slightly scattered, face coarse and closely punctured. Tergites I–III yellowish red, similarly to tibiae. T–IV-V black, bluish green tints laterally. Head and thorax green, propodeum, tegulae, femora mostly bluish-green. Disc of T–I and T–II–IV evenly closely punctured, without double punctures. 5.5 mm *collaris* LINSENMAIER ♂

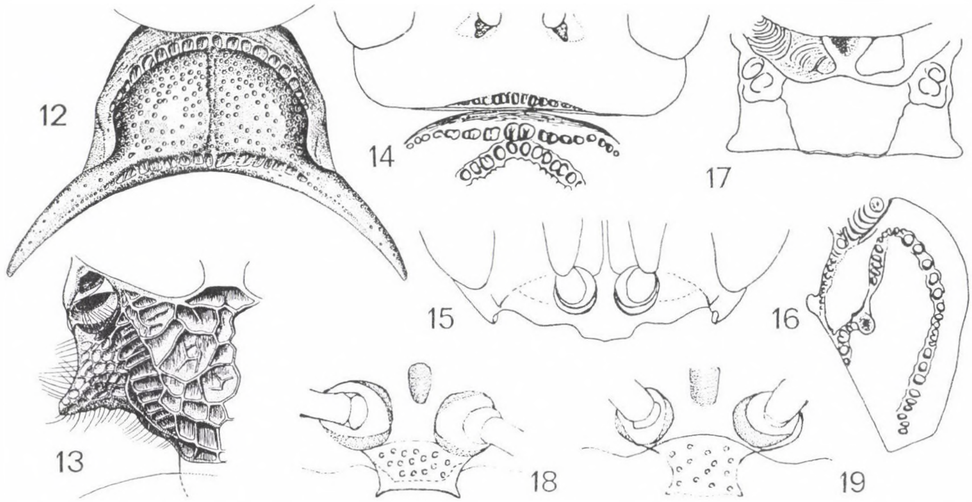
11 Supraoccipital furrow very strong and distinctly foveolate (Fig. 14). Transverse furrows of pronotum unusually strong and coarsely foveolate. Longitudinal sulcus unusually deep on pronotum medially. Lower margin of clypeus broad, with tridentate apex (Fig. 15). Frontal sulcus very deep basally, running from fore ocellus and gradually becoming shallow toward clypeus. Epicnemo-precoxal and epimeral furrows on mesopleuron (Fig. 16) connected with each other in front, very deep and strongly crenate excepting posterior portion of epimeral furrow. Mesonotum black with bronze reflection and with purple tints. Head, scape, pedicel, pronotum, coxa partly, femora and tibiae largely mainly on outside, greenish blue with violet tints. Propodeal disc and abdomen largely purple. T–IV bluish-green and with violet tints. Posterolateral angles of propodeum pointed. 10.2 mm
seoulensis TSUNEKI ♀

– Supraoccipital furrow absent or hardly discernible. Transverse furrows and midline on pronotum normally developed or shorter. Lower margin of clypeus narrower than before, straight, without tridentate apex 12

12 Body nearly entirely brilliant greenish blue, tegulae, terga with remarkably vivid violet reflection, head, pronotum and postscutellum only partly with violet tints. Scape, propodeum, mesopleuron, T–I in front together with T–I–II laterally and partly femora and tibiae more greenish. Apical margin of terga black. Postscutellum with an unusually large pit medially in front and with two smaller pits apically (Fig. 7). Frontal sulcus started in a distinct pit not near fore ocellus. Lateral margins of propodeum nearly parallel. Terga deeply and gradually densely, T–II closely, T–III–IV coarsely (Fig. 8) and partly double punctured. 6.5 mm *dipriovola* TSUNEKI ♂

– Body largely black, abdomen dark brown, partly with green, bluish or violet reflection T–III–IV densely, partly double (Fig. 10), not coarsely punctured 13

Figs 12–19. 12–13: *Cleptes mandsuricus*: 12= pronotum, 13= Propodeum. 14–16. *C. seoulensis*: 14= posterior part of head with anterior margin of pronotum, dorsal view; 15= lower face, front view, 16= Mesopleuron, lateral view. 17= *C. fudzi* postscutellum and propodeum, dorsal view. 18–19. Clypeus, frontal view of *C. fudzi* and *C. sjoestedti* (Figs 14–17 according to TSUNEKI)



13 T–I nearly impunctate, with only very fine and sparse punctures ♀ ♂, T–II–IV with very dense, partly double punctures (Fig. 10). Abdomen dark brownish black; T–I chestnut brown in front and together with T–I–IV on posterior margin, or with pale or moderate bluish green and violet (♀), or extended bluish reflection (♂). Head, pronotum, whole mesonotum nearly entirely black, sometimes with bronze tints (♀ ♂), vertex rarely with violet tints. Scutellum, postscutellum and propodeum bluish green, green or blue with more or less violet reflection (♂). Propodeum with lateral margin parallel, lateral teeth stumpy ♀ ♂ (Fig. 17). Lower margin of clypeus with a distinct acute tooth pointed and directed obliquely at the corners (Fig. 18). ♀ 9 mm, ♂ 6.7–7.5 mm *fudzi* TSUNEKI

– T–I with distinct and sparse punctures 1–3 PD apart. Terga largely with distinct violet reflection (♀), or traces of violet tints (♂). Mesonotum only medially blackish green (neotype) or black, lateral lobes with violet tints (♀ from Korea), vertex and pronotum bluish, partly with violet tints. Scutellum, postscutellum dark blue with violet tints (♂). Propodeum with lateral margin concave before angles, lateral teeth slender (Fig. 11) produced obliquely. Lower margin of clypeus hardly bulging into a minute tooth directed laterally (Fig. 19). ♀ 9, ♂ 5.5 mm *sjoestedti* HAMMER

Cleptes aerosus FÖRSTER

Cleptes aerosus FÖRSTER, 1853: 329 ♂. Holotype ♂; Hungary: Budapest (HNHM).
Cleptes Abeillei BUYSSON, 1887: 6, 3 ♀, France: Vernet (Allier), BUYSSON 1888: 2, 3 ♂.
Cleptes Abeillei var. *soror* MOCSÁRY, 1892: 213, 1 B. Holotype ♀ ; Greece: Mt. Parnassus (HNHM).
Cleptes aerosus: MÓCZÁR 1962: 112 (lectotype desig. erroneously).
Cleptes abeillei: KIMSEY, 1986: 106, desig. lectotype: Allier (Paris).
Cleptes soror (*abeillei* var.) 1893 (correctly 1892): KIMSEY and BOHART 1991: 58 ♀ (as synonym).
Cleptes aerosus: KIMSEY and BOHART 1991: 58 (lectotype ♂).

Material examined: 7 ♀, 9 ♂. Hungary: "Budapest leg. Kovács Gy.", "Hung." (it is in the original diagnosis), "Cleptes aerosus Först. det. MOCSÁRY", "Holotype Cleptes aerosus Först. ♂ det. MÓCZÁR", (Budapest Hym. Typ. No. 3852), 1 ♂ (HNHM). Budapest (Szépligeti), 1 ♀, Remetehegy (Bajári); 1 ♂, Paks (Horváth E.). – Croatia: Novi (Horváth G.), 2 ♂. – Bosnia-Hercegovina (Dr. Hensch), 1 ♂. – Greece: "Graecia Krüp. 92" with MOCSÁRY's handwriting, "Abeillei Buyss. typ. v. soror Mocs. det. Mocsáry", "Holotypus *C. Abeillei var. soror Mocsáry*" (Budapest Hym. Typ. No. 3853), 1 ♀ (HNHM). – Georgia: Nucha prov. ♀ (2.VI.1904) (as "radoszkowskii Rad." det. A. SEMENOV-TIEN-SHANSKY), really 1 ♂ (HNHM). – Armenia: lac. Gokca, Savang Exp. Savang 1903, "det. M. Nikolskaya" (ZIP). – Bohemia: Veletoy-kolin. – Switzerland: P.IS (Peney), 1 ♀; Helvetia P. 1 ♀; P. Moul, 1 ♂. – France: Le Vernet, Cleptes Abeillei R. du BUYSSON 1887 1 ♀, 1 ♂ (all HNHM). The dates of collection were mainly July and in two cases May and June.

Addition to the original diagnosis. Nervulus antefurcal. The following table compares the proportions. The numbers were obtained by dividing the length of the studied morphological part by its width.

	MS:MOD	Ped	F-I	F-II	F-III
aerosus ♂ (holotype)	1.8 long	1.9	2.9	1.6	1.4
♂ spec. from Nucha	1.7	1.8	3.0	1.8	1.6
♀ spec. from Armenia	2.0	2.0	2.4	1.4	1.1
soror ♀ (holotype)	2.2	2.0	2.5	1.4	1.1

The variability of this species is rather large both in sculpture and in colour. For example the posterior row of pits of the pronotum is feebly developed in the holotype or in one male from Novi (coll. 12. VII. 1899), but it is well-distinguishable in other males, among them a male also from Novi (collected 1896). Longitudinal mid-line of pronotum shallow and developed only on anterior half of disc (holotype ♂), usually longer or when sometimes developed posteriorly, then indistinct in front (♀ ♂). The size of the lateral angles of propodeum is different on the right and on the left side in the very same specimen (Budapest: Remetehegy, coll. 1954). The oval and round or narrow pit on vertex between hind ocelli does not restricted to males or to females. T–I usually with fine and dense punctures 1–3 PD apart (*soror* holotype) or denser, nearly closely punctured 0–1 PD apart (Budapest ♂ holotype, France). Lower face largely black (♀), or green with few violet tints in holotype (♂) and large violet or black, also me-

dially in other males: scutellum rarely with copper tints (♀), or largely golden green ♀ ♂ with red tints (♂), etc.

Distribution. Hungary (FÖRSTER 1853). Southern parts of Central and Southern Europe, Oran (Algeria) and Georgia.

Cleptes aerosus franciscae LINSENMAIER

Cleptes aerosus franciscae LINSENMAIER, 1987: 133, 1 ♀. Holotype ♀; Morocco: Mogador (CL).
Cleptes aerosus franciscae: KIMSEY and BOHART 1991: 58 ♀.

Material examined: 1 ♀ Morocco: "Maroc 30.IV.65 Mogador Taffet leg. Linsenmaier", "♀ Type Cleptes Ltr. aerosus franciscae Lins. Linsermaier det 1965", "Holotypus C. aerosus franciscae Lins. des. Móczár 998" (CL).

Distribution. Morocco (LINSENMAIER 1987).

Cleptes collaris LINSENMAIER

Cleptes collaris LINSENMAIER, 1959: 91, 1 ♂ Fig. 710. Holotype ♂; Turkey: Ciftehan (CL).
Cleptes collaris: KIMSEY and BOHART 1991: 59 ♂ (*aerosus* group).

Material examined: 1 ♂. Turkey: "Ciftehan (Taurus) 10.6.58 Seidenstücker", "♂ Type Cl. collaris Lins. 58 Linsenmaier det.", "Holotypus C. collaris Lins. des. Móczár 998" (CL).

Distribution. Turkey (Taurus) (LINSENMAIER 1959).

Cleptes dipriovola TSUNEKI

Cleptes dipriovola TSUNEKI, 1982: 1, 1 ♂. Holotype ♂; Thailand: Chiang Mai (OMNH).

Material examined: "Thailand Chiang Mai", "Chang" in original description, "Diprion 1980" (both labels with further Japanese writing), "Cleptes dipriovola Tsuneki A Holotype" orange label (OMNH).

The holotype corresponds to the original description, except the abdomen is differently punctured (Fig. 8), given in detail in the key (not "gaster above finely closely punctured").

Additions to the original diagnosis. Anterior vein of discoidal cell pale, nervulus distinctly antefurcal. Lower margin of clypeus convex with nearly rectangular corners. MS 1.6 MOD long. Ped 1.3 times as long as wide, F-I 2.4 ×, T–II 1.6 times as long as wide.

Distribution. Thailand (TSUNEKI 1982).

Cleptes fudzi TSUNEKI

Cleptes fudzi TSUNEKI, 1959: 14, 1 ♀, 3 ♂ Figs 7, 13–17. Holotype ♀; Japan: Youga-cho (OMNH)
Cleptes fudzi: KIMSEY and BOHART 1991: 60 ♀ (Tsukuba).

Material examined: 3 ♀, 1 ♂. Japan: "Youga-cho, V.24.1933. Col. A. Y.","Cleptes fudzi TSUNEKI Holotype" 17 IV 1964, 1 ♀ (red label) (OMNH): Oshibahara VIII 1963, 1 ♀ (CNC), and 28 IV 1964 ex *Neodiprion sertifer* (GEOFFROY) 2 ♂ (CNC and HNHM).

Additions to the original description. ♀ = MS 2.3 MOD long. Ped 2.0 times as long as wide, F-I 2.2×(not 2.8× as in TSUNEKI), F–II 1.2× and T–III 1.3 times as long as wide. Anterior vein of discoidal cell only partly developed, nervulus antefurcal (♀ ♂). ♂ (collected ex the same sawfly) = MS 1.3 MOD long. Ped 1.4 times as long as wide, F-I 2.2×, F–II 1.7×, F–III 1.4 times as long as wide. Head coarsely, pronotum, mesonotum densely 1–2, partly 0.5–2 PD apart. The deep pit of postscutellum in front lengthened and pointed, similar to that in female. T–II–III densely 1–1.5 PD at base and 1–2 PD apart posteriorly; T–IV with partly scattered punctures 3–4 PD apart (Fig. 10). Double punctures in male of T–III–IV distinctly stronger than in female.

Sculpture and colour are also different. Mid-line of pronotum is feebly developed posteriorly in holotype, hardly distinct anteriorly in one female or normally developed along the disc in one female and male, which were collected in the same locality. Scutellum, propodeal disc laterally green, central area of propodeum dark green and postscutellum violet in holotype; scutellum, propodeum bluish violet with dark blue central area, and postscutellum dark violet in the other females, all collected in the same locality. The same difference can be seen in the colour of the male terga as given in the key.

Distribution – Japan (TSUNEKI 1959).

Cleptes ignidorsum sp. n. ♂
(Figs 1–5)

Holotype A: Gruzia: Prov. Tiflisens. "Lagodechi", "30.V.07", "Mus. Caucas 60–07", "Holotypus ♂, Cleptes ignidorsum sp. n., det. MÓCZÁR 997", 1 ♂ (Budapest Hym. Typ. No. 3858) (HNHM).

Length 7.0 mm. Vertex, pronotum (except for green collar, lateral side and pits row of posterior margin), as well as mesonotum and scutellum flame red. Lower face, clypeus, mandible base, scape, lateral side of mesonotum, coxae and outerside of hind femora and tibiae green, with golden tints. Outer side of fore femora greenish blue, of middle ones with metallic highlights. Fore and middle tibiae yellowish brown, with less greenish tints; tarsi yellowish brown. Pedicel, except for few greenish tint and flagellomeres, trochanters and hind femora inside brown. Abdominal segments I–II nearly entirely, T–III laterally with larger, and T–IV with a smaller, lateral yellowish red colours; T–II posteromedially, T–III largely triangularly black, T–IV nearly entirely, T–V entirely black. Wings hyaline, only radial cell hardly infuscated. Body covered with erect brownish hairs.

Head 1.2 times as broad as long (measured including clypeus), with close punctures; with very deep and large pits outside of the ocelli, similarly to *aerosus*. Vertex hardly raised between the pits of hind ocelli; instead of a sulcus is a small pit medially. Ocellar triangle acute, 1.5 times as far from eye margin as from one another; POL:OOL = 15:10. Frontal sulcus distinct, reaching to the pits of fore ocellus (Fig. 3). Lower face concave. The lateral margins of clypeus convergent downwards but nearly divergent just before the slightly arcuate apical margin; lateral angles nearly in an acute triangle; surface with large and deep punctures. MS 1.4 MOD long. Pedicel 2.0 times as long as wide; F-I 3.2 × apical width, F–II 1.9 ×, F–III 2.0×apical width; lower side of F–III hardly, of F–IV-XIII flattened and lighter brown. Pronotal punctures 0 to 1 PD apart in front medially and 1–2 PD apart posteriorly beside the middle (Fig. 1).

Mesonotum and scutellum with scattered punctures, punctures 0.5 to 2.5 PD apart or more medially. Postscutellum oblong, anterior margin with a small pit medially; and with a minute irregular row of deep pits between scutellum and postscutellum (Fig.2). T–I–II–III closely punctured, T–IV with double punctures, T–V smooth, polished.

♀. – Unknown

This species is closely related to *C. aerosus* FÖRSTER but differs from it as given in the key (couplet 6 and –) near to *C. radoszkowskii* RADOSZKOWSKI as follows: hind tibiae not yellowish brown on both sides; and T–I and T–II not with similarly close punctures, etc.

Cleptes juengeri LINSENMAIER

Cleptes juengeri LINSENMAIER, 1994: 514, 7 ♀ Figs 1–2. Holotype ♀; Spain: Soria (CL).

Material examined: Paratype, 1 ♀. Spain: "Spanien Soria 19.6.94 Linsenmaier", "♀ Paratype Cleptes Latr. juengeri Linsenmaier det. 1994" (Budapest Hym. Typ. No. 3856) (HNHM).

Addition to the original description: MS 2.4 MOD long. Ped 2.3 times as long as wide, F-I 2.4 ×, F.II 1.6 × and F–III 1.4 times as long as wide.

Distribution – Spain (LINSENMAIER 1994).

Cleptes libanoticus LINSENMAIER

Cleptes libanoticus LINSENMAIER, 1959, 9 ♂ Fig. 711. Holotype, ♂; Libanon: Mt. Barouk (CL).
Cleptes libanoticus: KIMSEY and BOHART 1991: 61 (*aerosus* group).

Material examined: 1 ♂. Lebanon: "Lebanon mt. Barouk 22.V.1953 Mavromoustakis", "Type Cleptes libanoticus Lins. det. Linsenmaier 59", "Holotypus C. libanoticus Lins. des. Móczár 998" (CL).

Distribution – Lebanon (LINSENMAIER 1959).

Cleptes mandsuricus MÓCZÁR

Cleptes mandsuricus MÓCZÁR, 1968: 171, 1 ♂ Figs 5–7: Holotype ♂; China: Manchuria, Erzendjanzsy (ZMU).
Cleptes mandsuricus: KIMSEY and BOHART 1991: 61 ♂ (*aerosus* group).

Material examined: Holotype, 1 ♂. China: "Mandschurei Erzendjanzsy 5.VI.37", "Holotypus Cleptes mandsuricus ♂ Móczár det. Móczár L. 1967" (ZMB).

Additions to the original description. MS 1.4 MOD long. Ped 1.6 times as long as wide, F-I 2.2 ×, and F–II 1.8 × as long as wide. Lateral margins of postscutellum convergent posteriorly; disc with a pit in front medially; posterior margin broadly and arcuately foveate (Fig. 13) with a hardly perceptible septum lying deep medially. Anterior vein of discoidal cell hardly distinct basally. Nervulus remarkably antefurcal.

Distribution – China (Manchuria) (MÓCZÁR 1968).

Cleptes moczari LINSENMAIER

Cleptes moczari LINSENMAIER, 1968: 4 ♀ ♂. Holotype ♀; Greece: Alt-Korinth (CL).
Cleptes moczari: KIMSEY and BOHART 1991: 61 ♀ (*semiauratus* group).

Material examined: 3 ♀, 8 ♂. Greece: "Altkorinth Graecia 31.5.1963 leg. K. Kusdas", "Paratype ♀ Cleptes Ltr. moczari Linsm. Linsenmaier det. 1965", 1 ♀,1 ♂ (Budapest Hym. Typ. No. 3854–3855) and Alt-Korinth Pelop. VI.1963, V.1964 (M. Schwarz and J. Schmidt), 2 ♀, 7 ♂ (HNHM).

The specimens correspond to the original description except the colour largely violet with few (♀) or more (♂) greenish and bluish reflections (not "ziemlich gleichmässig blaugrüne bis grünblaue Färbung von Kopf und Thorax... nur Meta-Thorax hinter dem Metanotum mehr violetblau bis dunkelviolet"). The average length of the above specimens is 5.4 mm ♀ ♂, one male is only 4.2 mm.

Additions to the original description. ♀ = MS 2.6 MOD long. Ped 2.4 times as long as wide, F-I 2.7 ×, F–II 1.5 ×, F–III 1.0 times as long as wide. Nervulus interstitial or rarely hardly antefurcal (♂). Head closely, pronotum deeply punctured, punctures 0–1 PD apart, on scutellum scattered, 1 to 3 PD apart ♀ ♂. The row of minute fovea usually shorter in front of postscutellum than in the smallest male. ♂ = MS 1.8 MOD long. Ped 2.4 times as long as wide, F-I 2.5 ×, F–II 1.7 ×, F–III 1.4 times as long as wide.

Distribution – Greece (LINSENMAIER 1968).

Cleptes radoszkowskii RADOSZKOWSKI

Cleptes radoszkowskii MOCSÁRY (Inédite) RADOSZKOWSKI, 1889: 23: 7 ♀ ♂ Figs 5a-c,i,k. Lectotype ♀ (desig. herein); Russia: Caucasus (ISK).
Cleptes radoszkowskyi MOCSÁRY, 1889: 44 ♀ ♂ (description in 1888); BUYSSON 1891: 83 ♀ (sec. sp. typ. Caucase); BUYSSON 1900: 125 (Oran).
Cleptes radoszkowskii: SEMENOV T. S. 1920: 313.
Cleptes radoszkowskii: KIMSEY and BOHART 1991: 63 (syntype ♂ ♀, "Caucasus", Krakow, *semiauratus* group)

Material examined: 2 ♀, 5 ♂. Russia: "Caucas Nlocos", "Lectotypus C. ♀ radoszkowskii Rad. des. Móczár 997" (left antenna, left middle and hind legs and right fore legs missing), 1 ♀ lectotype (ISK); "Caucas(us) MLOK", a round golden paper, "Radoszkowsk Moc", with author's handscript, "Paralectotypus Clep. ♀ radoszkowskii Rad. des. Móczár 1997" (both antennae, left fore leg and right wing partly wanting) 1 ♀ (ISK); "a-Cauc"(asus) (abdominal segments III–VI wanting, more correctly last segments with the sternite and some portions of male genitalia lies on label in glue), further labels: "Paralectotypus Cl. radoszkowskii Rad. des. Móczár 1996" and "Cleptes femoralis Mocs. ♂ det. L. Móczár 1996", 1 ♂ (ISK); "Caucasus", "Type", "Radoszkowsk ♂" RADOSZKOWSKI's original writing, "Paralectotypus Cl. radoszkowskii Rad. ♂ des. Móczár 1997", "Cleptes femoralis Mocs. ♂ det. Móczár 1995" 1 ♂ (ZMB); Gruzia: "Lagodechi", 1 ♂ (see in *ignidorsum* sp. n.); Nucha 1 ♂ (see in *C. aerosus* FÖRSTER); "Astradamovka Jun Mugan ASSR 17.Jun 1927 (Bogarnikov)", "Cleptes radoszkowskii Rad. nov. ♂ det. Móczár 1997", 1 ♂ (Hym. Type No. 3856, Budapest, HNHM).

The status of this species was very uncertain, because the original diagnosis was very short (♀ ♂). In RADOSZKOWSKI's diagnosis: "Mas. Assimilis Cl. nitidulae; squammulis piceis, tarsis posterioribus brunneis. Long. 6 mm. Armure… fig. 5k." For this reason it belongs to the subgenus *Leiocleptes* (pronotum without any pits-row and mid-line). The first examined syntype (♂) found in Berlin (with an intact abdomen), as well as the second syntype (♂) requested for some years ago from Krakow (in the latter the genitalia was separated and delineated by RADOSZKOWSKI), all belong to *Cleptes femoralis* MOCSÁRY. MOCSÁRY (1889) published a detailed description (♀ ♂), based on the material sent to him by RADOSZKOWSKI.

SEMENOV (1920) examined 1 ♂, published 2 specimens as "radoszkowskii Rad. 1888" ♀, ♂ from Lagodechi and Nucha. The specimen from Lagodechi proved to be *C. ignidorsum* sp. n. ♂ and from Nucha *C. aerosus* FÖRSTER ♂ (not ♀).

The male from Astradamovka seems to be the previously unknown, true male (subgenus *Holcocleptes*), described in the key and below, which agrees with the female in some respects. Finally, after returning the male, I received two female syntypes from Krakow. They are identical with the original diagnosis and with MOCSÁRY's description. Consequently, I designate the first described female as lectotype and the paralectotypes (♀, ♂) of this species.

Additions to the original diagnosis and the description of the previously unknown male. The comparison of the proportions of the specimens and of *radoszkowskii* with *femoralis* are as follows:

	MS:MOD	Ped	F-I	F-II	F-III
radoszkowskii lectotype	1.7	2.3	2.9	1.6	1.3
paralectotype ♀	1.7	–	–	–	–
Astradamovka ♂ new	1.3	1.7	3.0	1.7	1.7
femoralis MOCSÁRY ♂	0.8–1.0	1.8	2.5	1.9	1.8
Krakow, paralecto. ♂	0.8	1.8	2.5	1.9	1.9
Berlin, paralecto. ♂	0.8	1.8	2.5	1.9	1.9

♀, ♂ – Pronotum, mesonotum and scutellum flame red. Lower face green. Fore and middle tibiae and tarsi yellowish brown. Abdominal segments I–II yellowish brown entirely, III only basally, and with large spots laterally; T–III posteriorly and IV black without metallic colour, T–IV with narrow yellowish brown lateral streaks. Head 1.2 times as broad as long. Frons (Fig. 5), pronotum with rather deep and dense, partly coarse punctures, punctures about 0.5–1 PD apart. Mesonotum, scutellum with distinctly smaller and scattered punctures. Ocellar triangle in front rectangular 1.2 times (♀) or 1.5 times (♂) as far from eye margin as from each another. Lateral margins of clypeus parallel, angles nearly rectangular, apical margin straight; surface entirely (♀) (Fig. 5) or only apically (♂) punctured.

♀ = Vertex flame red behind ocelli, along inner eye margins and between the black spot and the green lower face. Along frontal sulcus golden. Pronotal collar blackish or dark green (in paralectotype ♀). Propodeum greenish blue. Mesopleuron bluish green or with golden tints. Fore and middle femora green, partly violet, hind femora black nearly entirely with greenish tints. Nervulus interstitial or antefurcal in a small degree. Radial cell slightly brownish stained. Body partly with white and brownish hairs.

♂ = Vertex entirely flame red. Scape, mandible base, clypeus bright green. Scutellum golden. Sides of pronotum, collar and femora bluish green. Propodeum, mesopleuron and coxae largely bluish with more or less violet reflections. Wings hardly infuscated. Nervulus strongly antefurcal. Body with white hairs. Mesonotum with punctures 1–2 PD, scutellum with 1–3 PD apart. Punctures of T–II 1–2 PD or more apart.

Distribution – Russia, Caucasus (RADOSZKOWSKI 1889), Astradamovka.

Cleptes radoszkowskii flammifer SEMENOW **stat. n.**

Cleptes flammifer SEMENOW, 1891: 180, 1 ♀. Holotype ? (? ZIP).
Cleptes flammifer: SEMENOV (sic) 1920: 314, 323
Cleptes flammifer: KIMSEY and BOHART 1991: 60. Holotype ♀. (as 1892: 498, *semiauratus* group) (ZIP).

Material examined: None.

Note. According to the diagnosis "sine ulla indicatione loci incolendi … verisimiliter … ex Europe meridionali". SEMENOV published later (1920: 314):

"Ceterum cum *C. radoszkowskii* Rad. congruens et fortasse ejus subspecies tantum". One specimen was found before the drawer label "flammifer Semenov" with the label "M. Nikolskaya det", but without species name in the collection of museum in St. Petersburg. This female from Armenia (Sevang) proved to be an *aerosus* FÖRSTER (see above). It was collected only in 1903. Being of the same opinion as SEMENOV (1920), I regard *C. flammifer* as a subspecies of *C. radoszkowskii* at most.

Distribution – ? Southern Europe (SEMENOW 1891).

Cleptes seoulensis TSUNEKI

Cleptes seoulensis TSUNEKI, 1959: 13, 1 ♀ Figs 8–12. Holotype ♀; Korea: Keijo (OMNH).
Cleptes seoulensis: KIMSEY and BOHART 1991: 64, 1 ♀. (Tsukuba, *orientalis* group).

Material examined: 1 ♀. Korea: "Keijo Kosidou Keijo-C 5–7–1934 S. Eguchi", "Cleptes seoulensis TSUNEKI Holotype" (red label),"N. Tosawa Collection, June, 1798", 1 ♀ (OMNH).

The description agrees with the holotype and differs only as follows. Ocelli in acute triangle (not in a nearly equilateral triangle, as in TSUNEKI). Additions to the diagnosis. Anterior vein of discoidal cell slightly indicated, nervulus interstitial, nearly antefurcal. Head, pronotum, mesonotum basally with close punctures, laterally, posteriorly and scutellum densely punctured, punctures 1–1.5 PD apart. T–I with fine, scattered punctures, 1–3 PD apart, T–II –III with deeper, dense and T–IV with distinctly double punctures (Fig. 9). MS 1.8 MOD long. Ped 1.9 times as long as wide, F-I 2.2 ×, T–II 1.4 ×, T–III 1.2 times as long as wide.

Distribution – Korea (TSUNEKI 1959).

Cleptes sjoestedti HAMMER

Cleptes Sjöstedti HAMMER, 1950 (February): 2, 2 ♀. Neotype ♀ (desig. herein); China: Kiangsu (NMW).
Cleptes sjostedti: KIMSEY and BOHART 1991: 64 ♀ (Stockholm, *orientalis* group).
Cleptes pinicola LIN, 1959: 205, 2 ♀. Holotype ♀; Taiwan: Lien-hwa-ch ich (Rengechi) (TARI). Syn. n.

Material examined: 7 ♀, 1 ♂. China: "Provins Kiangsu", "China Koltboff" (sic, in diagnoses by KOLTHOFF), "okt", "Type" (red label), "Coll. Hammer", "Cleptes sjöstedti ♀ Type Hammer", "Neotypus Cleptes sjoestedti Ham. det. Móczár 1995", 1 ♀ (NMW): n(ea)r Fcochow (C. R. KELLOG), 1 ♀ and Komaba 5.IV.1899, 1 ♂ (USNM). – Taiwan: "Rengechi 8 4 1924 Col. J. Sonan", "Cleptes ♀ pinicola LIN (Holotype) det. VII.1958" (red label), 1 ♀ and Tao-Ping-chi, Miao-Li Hsien IX.1963, reared from cocoon of *Nesodiprion japonica* Marl., K. S. LIN det. (M. T. Tang), 1 ♀ (TARI). – Korea: Suigen V-VI. 1928 ex saw-fly cocoons (T. R. GARDNER and C. P. CLAUSEN), 2 ♀ (USNM), 1 ♀ (HNHM).

HAMMER reported the depository of the type material "holotype in Stockholm and paratype in coll mea" (Wien). From the kind letter of FREDRIK RONQUIST (NRS): "I have not been able to find the type of *C. sjostedti* in the collection... This probably means that it not returned to the Museum in Stockholm by Dr HAMMER... However, this type appears to be lost." Consequently, I designate HAMMER's paratype located in Wien as neotype (Internat. Code of Zool. Nomenclature 1985 part 75).

The neotype of *sjoestedti* and the holotype of *pinicola* agree well with one another, and with the original diagnosis, differing only as follows. Length of the neotype 8.5 mm (not 10 mm as in HAMMER's diagnosis), length of *pinicola* 8 mm (not "about 5.5–8 mm" as in LIN's diagnosis. The "broad, pale brown transverse fascia below radial cell" according to LIN (l. c.: 207) indistinct on neotype from China, Korea and lacking in *pinicola*. Clypeus hardly bulging, nearly straight with a minute tooth on the corners (Fig. 19) (not "zweimal gebuchtet... winkelig abgerandet", as in HAMMER's diagnosis)

The following detailed characters are partly missing from the original diagnosis. Head largely greenish blue and violet purple around ocelli (neotype) or largely violet and black around ocelli (Korea) or bluish green with violet tints (*pinicola*). (Also in the following text, the name of the country always refers to *sjoestedti* specimens or to the neotype of *sjoestedti*.) Pronotum black with violet and greenish blue reflection laterally (neotype), or black, partly violet and bluish green tints (Korea). Mesonotum black (Korea, 3 spp.) and with few violet tints (neotype) or with bluish green tints (*pinicola*, and 1 sp. China). Scutellum dark greenish black. Abdominal terga largely violet and greenish blue laterally and in front (neotype and Korea) or violet only medially and greenish blue otherwhere (*pinicola*, 1 ♀ China). These small differences and the inconsistent colour aberrations listed above are not sufficient to consider *C. pinicola* as a distinct species. Consequently, I consider it a synonym of *C. sjoestedti* HAMMER.

Further additions in relation to proportions of malar space and flagellomeres of *sjoestedti* neotype – *sjoestedti* species from Korea – *pinicola* holotype (in this succession): MS 1.8–1.9–? MOD long. Ped 2.1–2.0–2.0 times as long as wide, F-I 2.4 -2.4 -2.2 ×, F–II 1.2–1.3–1.3 times as long as wide. Anterior vein of discoidal cell incomplete (neotype) or pale (Korea), nervulus antefurcal. T–II densely punctured on the anterior two-thirds. T–III–IV deeper, largely closely, more strongly punctured.

The previously unknown male agrees with the female in the colour of the head, thorax and in sculpture, but differs as follows: length 5.5 mm. Vertex and pronotum partly, mesonotum largely black, partly with violet tints. All flagellomeres dark brownish except dark bluish scape above. T–I–IV brown, only with traces of pale violet tints. T–V entirely, T–I–IV in some places lighter brownish chestnut coloured. Coxae with greenish blue, femora and tibiae with violet reflec-

tion. Ped 1.4 times as long as wide, F-I 2.7 ×, F–II–III 1.2 × and F–IV 1.4 times as long as wide. Terga III–IV with double and remarkably stronger punctures than in female.

Distribution – China (HAMMER 1950). Taiwan and Korea.

* * *

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The oribatid species described by Berlese (Acari)

MAHUNKA, S. and L. MAHUNKA-PAPP

The authors had the opportunity for years to study the Oribatid species described by Berlese currently deposited in the Istituto Sperimentale per la Zoologia Agraria at Florence. The results of this series of studies are summarized in this volume.

The volume begins with an essay-like Introduction heavily relying on subjective opinions discussing the general questions of Oribatology. The following section lists Berlese's species placed in the modern system helping the specialists with morphological notes and many drawings; here also the condition of the specimens is discussed and lectotypes are designated.

The third, large section is the catalogue proper, wherein all the species are listed in the systematic order together with their combination and synonymic names. Here one may find all the literature data, usually missing from ordinary works, with reference to Description and Taxonomy, Distribution, with special emphasis on Catalogues whose references are partly unreliable. Where it was deemed necessary further information are added under the heading of Remarks. The volume closes with a very detailed list of literature.

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MORPHOLOGY OF THE SMOOTH NEWT (TRITURUS VULGARIS) IN FORMER YUGOSLAVIA: TAXONOMICAL IMPLICATIONS AND DISTRIBUTION PATTERNS

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The morphological traits of the smooth newt, *Triturus vulgaris* (LINNAEUS, 1758), have been studied in a considerable number of population samples from former Yugoslavia, taxonomically the most intriguing area of the Balkans. We found a great deal of variation in various morphological traits, more than previously thought, including those used to delimit subspecies. However, relevant taxonomic conclusions could be suggested from such variability patterns. We reaffirmed the possibility of the existence of two separate population groups within the range of the *T. v. graecus* subspecies. One group occurs in the area of southern Herzegovina and Montenegro, which was described a long time ago as the *tomasinii* form or subspecies (*T. v. tomasinii*). The other group is from the Former Yugoslav Republic of Macedonia (*T. v. graecus* sensu stricto). Rather broad intergradation zones of *tomasinii* × *T. v. vulgaris* and *T. v. meridionalis* × *T. v. vulgaris* were determined. The former zone occurs mostly in the Oromediterranean part of the Dinaric Alps. It was found that the ranges of the smooth newt subspecies followed the Balkan zoogeographical divisions to some extent.

Key words: smooth newt, *Triturus vulgaris*, morphology, former Yugoslavia

INTRODUCTION

Smooth newt, *Triturus vulgaris* (LINNAEUS, 1758) populations, mainly those restricted to small and marginal areas of the species range in the Balkans and Asia Minor coastal area, have undergone considerable evolutionary diversification. The subspecies differ mainly in the secondary sexual morphological traits of the males, such as the dorsal crest, tail tip, toe flaps, dorso-lateral folds and colouration, as well as body size. Such divergences have been differently viewed in terms of recognizing subspecies (MERTENS & WERMUTH 1960, BRAME 1967, THORN 1968, STEWARD 1969, for a historical survey see RAXWORTHY 1990). The last taxonomic revision of the smooth newt (RAXWORTHY 1990) recognized seven subspecies: *T. v. vulgaris* (LINNAEUS, 1758), *T. v. meridionalis* (BOULENGER, 1882), *T. v. graecus* (WOLTERSTORFF, 1905), *T. v. lantzi* (WOLTERSTORFF, 1914), *T. v. ampelensis* FUHN et FREYTAG, 1952, *T. v. kosswigi*

FREYTAG, 1955, and *T. v. schmidtlerorum* RAXWORTHY, 1988. These taxa are considered to be clearly defined with intergradation zones that can be readily identified.

For a long time the Balkans, especially the Dalmatian coast and its neighbouring region, have been considered the most taxonomically perplexing part of the range of the smooth newt. It used to be assumed that from northwest to southeast, the subspecies *T. v. meridionalis*, *T. v. schreiberi* (WOLTERSTORFF, 1914), *T. v. dalmaticus* (KOLOMBATOVIC, 1907) and *T. v. graecus* replaced each other. Based on morphology, SCHMIDTLER & SCHMIDTLER (1983) disregarded *T. v. schreiberi* as a separate taxon, which was confirmed by electrophoretic data as well (KALEZIC 1984). The situation with *T. v. dalmaticus* was much more confusing. SCHMIDTLER and SCHMIDTLER (1983) found that specimens from the type locality of this subspecies were well within the intergradation zone of *T. v. vulgaris* and *T. v. graecus*. Obviously they did not give a separate taxonomic status to the smooth newt populations from the southern coastal zone in comparison with *T. v. graecus*, the southernmost Balkan subspecies. Electrophoretic studies, however, did not confirm this statement (KALEZIC 1984). Thus, the taxonomic status of these populations is unclear and deserves a more detailed morphological analysis. There is another taxonomic ambiguity related to the question as to whether the Pannonian smooth newt populations differ morphologically from the nominate ones, as proposed by SCHMIDTLER and SCHMIDTLER (1983).

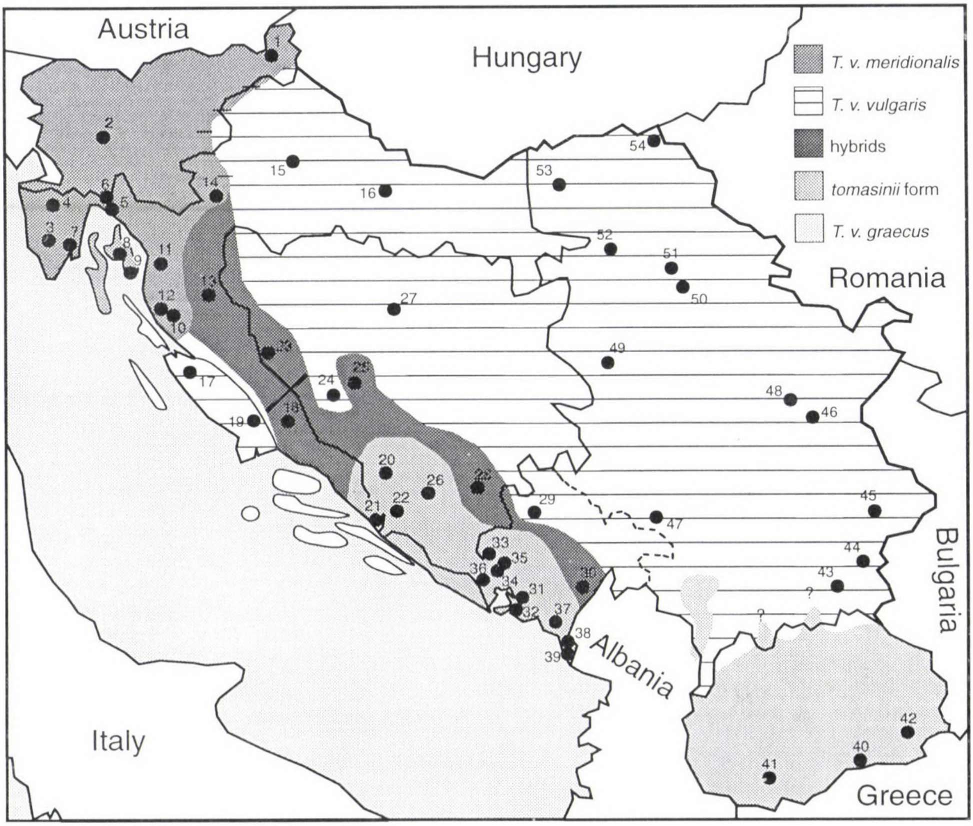
The variation patterns of smooth newt morphological traits, including the diagnostic characters both within and between populations, have not been fully explored to date on a micro-geographic scale in the former Yugoslavia. Herein we analyze 54 smooth newt population samples covering the taxonomically most intriguing areas, including those presumed to be in the intergradation zones. Numerous morphometric and qualitative external body traits were scored and population relationships were established using multivariate statistics, in order to shed more light on the above-mentioned taxonomic problems. Based on the results of this study, we made a new sketch of the supposed ranges of the subspecies (forms) of former Yugoslavia (for the previous map see DŽUKIC*et al.* 1990).

MATERIAL AND METHODS

Population studied

The newt population samples included only mature individuals collected during the breeding season. Population sample locations are shown in Fig. 1, while locality names, their UTM codes (10 × 10 km squares), and the number of females and males collected are listed in the Appendix. A total of 2682 individuals were subjected to analysis. The average number of females and males per population sample was 25.56±1.76, and 24.09±1.96, respectively. Specimens were preserved in

Fig. 1. Distribution of the sampling sites of *Triturus vulgaris* included in the analysis. The ranges of the subspecies and *tomasinii* form as explained in the Figure are indicated by different patterns. For numbers of the localities see the Appendix



70% ethanol for varying periods of time (1 to 7 years) before morphometric and qualitative characters were scored, and this can make some scoring imprecise, but hopefully not systematically so. (Specimens are deposited in the Georg Dzukic Batrachological Collection, Institute for Biological Research, Belgrade.)

Characters studied

Qualitative characteristics were as follows: I. Throat colour pattern – 1. pale with dark fused blotch, 2. pale with distinctive dark spots, 3. pale without spots. II. Colour of the central belly zone – 1. intensive with obvious marmoration, 2. intensive with weak marmoration, 3. pale with obvious marmoration, 4. pale with weak marmoration. III. Spots on the marginal belly zone – 1. distinctive, 2. weak, 3. without spots. IV. Dorsal crest: in males – 1. deniculated, >2 mm, 2. with approximately smooth edges, >2 mm, 3. deniculated, < 2 mm, 4. with approximately smooth edges, <2 mm; in females – 5. absent, 6. very low (< mm). V. Colour of the dorsal crest – 1. clear pigmentation continuously distributed throughout the surface, including the tail, 2. clear pigmentation along the upper and lower margins, 3. pigmentation only on the upper margin, 4. pigmentation weak or absent. VI. Dorsal crest starts – 1. on the back part of the head, 2. between the forelimbs, 3. between

the fore- and hind limbs. VII. Shape of the tail end – 1. the tip tapers off gradually to a fine point, 2. the tip tapers off gradually to a blunt point, 3. with a distinct short filament, 4. with a distinct moderately long filament, 5. with a distinct long filament. VIII. Toe flaps on the hindlimbs – 1. obvious, 2. not obvious, 3. without flaps. IX. The colour of the toe flaps – 1. obvious flaps with pale colouration, 2. obvious flaps with dark colouration, 3. not obvious flaps with pale colouration, 4. not obvious flaps with dark colouration. X. Dorso-lateral folds – 1. absent or weakly developed, 2. moderately developed, 3. well-developed. XI. Pigmentation of the ventral part of the tail fin – 1. without pigmentation, 2. up to three distinct dark spots, 3. 3–5 distinct dark spots, 4. > 5 distinct dark spots. XII. Spots on the ventral part of the tail fin situated on – 1. the upper tail fin margin, 2. the lower tail fin margin, 3. the upper and lower parts with a pale middle pelvic line, 4. distinct spots extended from upper to lower tail fin margins, 5. spots are fused. XIII. Flank background colour – 1. dark, 2. pale. XIV. Flank marmoration pattern – 1. distinctive spots, 2. spots unclear or absent, 3. reticulate pattern. XV. Tail background colour – 1. dark, 2. pale. XVI. Tail marmoration pattern – 1. distinctive spots, 2. spots unclear or absent, 3. reticulate pattern. XVII. Top of the head – 1. without a middle stripe, 2. with a middle stripe, 3. middle stripe not obvious, 4. with a white stripe between the rear eyeball margin and the corner of the mouth (in females only).

Morphometric characteristics

The following fifteen morphometric characteristics were measured with digital caliper (to the nearest 0.01 mm) for each individual: L - total length, Lcp - body length (from the snout to the front edge of the cloaca basis), Lsv - snout-vent length (from the snout to the posterior edge of the cloaca basis), Lcd - tail length (from the anterior edge of the cloaca basis to the tail tip), Ltc - head width, Lc - head length (from the snout to the corner of the mouth), Lh - tail height, Pa - forelimb length, Pp - hindlimb length, D - distance between fore and hind limbs, N - nostril width, In - distance between nostrils, Io - distance between front sides of eyeballs, IIo - distance between back sides of eyeballs, O - eyeball length. The length of the tail in damaged individuals was estimated as the expected value from the regression of Lcd on Lsv.

Data analyses

For statistical analyses the SAS package (SAS Institute 1990) was used, considering $p<0.05$ as the level for significance.

Individuals received a score on each qualitative character consisting of a discrete value for the colour and/or shape trait. These data were statistically analyzed using a correspondence analysis following the algorithm of GREENACRE (1984). The input data for this analysis were the two-way contingency tables of the observed frequencies of character states in the analyzed populations using the PROC CORRESP procedure. The output of such an analysis was the coordinates of the row (populations) and column (states of characters) correspondence axes superimposed on the scatter diagram. The proximity between populations is interpreted to evaluate not only the relationships among each set of variables, but also the relations among the row and column variables. The interpretation is based on points found in approximately the same direction from the origin and in approximately the same region of the space defined by correspondence axes. Distances between points do not have a straightforward interpretation in multiple correspondence analysis (GREENACRE & HASTIE 1987), so the obtained results allowed only evaluation of the relationships among populations according to the features of the correspondence axes estimated by the positions of the column variables on the scatter diagram.

Size differences between females and males were assessed using the single classification analysis of variance for unbalanced data applying the PROC GLM procedure that revealed significant differences between the sexes for most of the analyzed characteristics. To determine the amount of differences between sexes and among populations in terms of external morphology, a multivariate analysis of variance (MANOVA) was used. All test criteria (Hotelling's trace, Wilk's lambda and Pillais trace) showed a significant variation between both sexes and populations respectively. The data for the sexes were analyzed separately in further analyses.

Canonical variate analysis, which maximized the variation between groups, was used to characterize the degree of divergence among the populations (JAMES & MCCULLOCH 1990). The canonical variates were calculated (CANDISC) and the centroids of each sample population, without previously *a priori* designating populations to particular taxon, were plotted on the first two canonical axes.

RESULTS

Correspondence analysis indicates 50 dimensions in the correspondence table, but most of them are trivial and minor or of negligible influence on the mutual correspondence between rows and columns. The c2 of the first three singular values depicts about 40% of total χ^2 (39.2% and 42.4% in males and females, respectively).

We found a great deal of variation in qualitative characteristics, especially in males, with considerable interpopulation overlap even among different subspecies. Nevertheless, population samples are grouped in a recognizable manner, with more or less obvious taxonomic meaning (Fig. 2).

Populations from southern Herzegovina and Montenegro, named a *tomasinii* form (see Discussion), were mainly discernable from the remaining populations on the basis of the dominant phenotype characterized by the following features: spots on the ventral part of the tail fin situated on the upper tail fin margin,

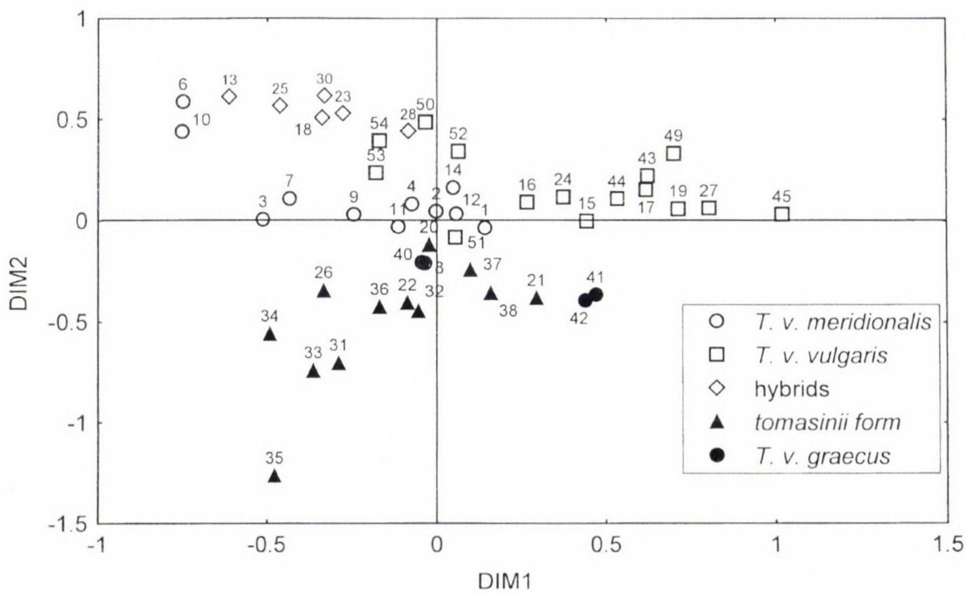


Fig. 2. Plots of populations for males on the first and the second correspondence axes (DIM). For numbers of the localities see the Appendix

pale flank background with reticulate pigmentation, dorsal crest starting further backward, and the tail ending with a distinct, mainly long filament. Two populations from the former Yugoslav Republic of Macedonia (*T. v. graecus*) were very close to this group. Individuals of these populations were characterized as follows: the tail ends with a distinct, short filament, the ventral part of the tail fin is without pigmentation, spots on the ventral part of the tail fin are situated on the upper and lower parts with a pale middle pelvic line or the spots are fused, females are with a white stripe between the back eyeball margin and the corner of the mouth.

Most of the populations from Slovenia and Croatia, which indisputably belong to *T. v. meridionalis* according to their geographical position, were mainly in the upper left quadrant being mostly concentrated around the zero value of the first two correspondence axes. These populations were mostly characterized by the following traits: a pale throat with fused dark blotches or with distinctive dark spots, a low and smooth dorsal crest starting from the back part of the head, the tail tip gradually tapers off to a fine point, moderately developed dorso-lateral folds on the body, pale flank background with distinctive spots, a head with a dark stripe down the middle.

Most of the populations geographically belonging to the nominate subspecies were situated in the upper right quadrant. These smooth newts typically had: up to three distinct dark spots on the ventral part of the tail fin, pale flank background with unclear spots or without them, the middle dark stripe not obvious on the top of the head, intensive colour on the central belly zone with weak marmoration, a deniculated crest under 2 mm, the tail tip tapering off gradually to a blunt point, the hindlimbs without flaps, dorso-lateral folds absent or weakly developed. Some of the Pannonian populations (Nos 50, 51, 53, 54) moved to the left, toward *T. v. meridionalis* and the populations from intergradation zones. Interestingly, a population of this group (No. 51) drifted out between the *tomasinii* and *T. v. meridionalis* groups.

Populations from the presumed integradation zones, regardless of the subspecies involved, formed a distinct group situated in the upper left quadrant. These populations were characterized by: tail colour with a pale background unclearly spotted, pale throat without spots, pale central belly zone with weak marmoration, marginal belly zone with weak spots, deniculated crest, well above 2 mm.

Correspondence analysis of fthe emales showed previously known indistinct taxonomic qualitative characters. Also, the females of most populations (37 out of 54) are morphologically very similar, i.e. with almost the same characters states concentrated mostly in the left quadrant, close to the zero value (Fig. 3). The position of other populations presents no more than a slight variation distributed unequally between populations, but without any taxonomic meaning.

Table 1. Correlations of the between population variability of analysed traits with the first three canonical axes (CAN) for both sexes

	males			females		
Traits	CAN1	CAN2	CAN3	CAN1	CAN2	CAN3
L	-0.215	0.616	0.691	-0.671	0.566	0.131
Lcp	-0.224	0.355	0.893	-0.737	0.508	0.265
Lsv	-0.212	0.439	0.856	-0.713	0.546	0.258
D	-0.403	0.173	0.828	-0.775	0.337	0.307
Lcd	-0.197	0.750	0.469	-0.577	0.601	0.015
Lh	-0.257	0.940	-0.126	-0.318	0.501	-0.760
Pa	0.050	0.624	0.742	-0.507	0.828	0.088
Pp	0.044	0.503	0.826	-0.518	0.797	0.174
Ltc	0.253	0.650	0.644	-0.356	0.895	0.076
Lc	-0.062	0.559	0.619	-0.574	0.651	0.206
N	-0.101	0.410	0.187	-0.282	0.413	0.215
In	0.835	0.444	0.189	0.743	0.531	0.047
Io	0.573	0.535	0.520	0.035	0.911	0.090
Iio	0.473	0.655	0.465	0.076	0.882	-0.062
O	0.731	0.250	0.414	0.636	0.531	0.169

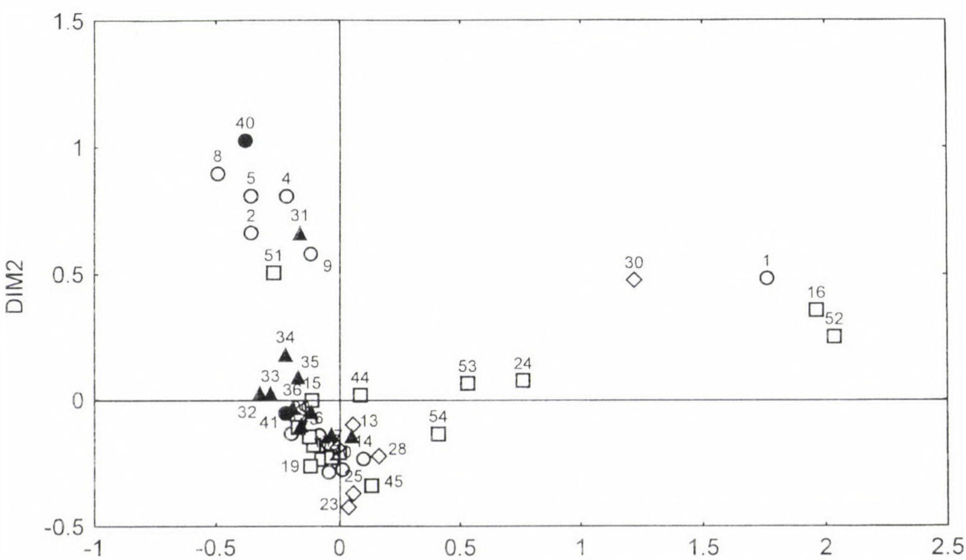


Fig. 3. Plots of populations for females on the first and the second correspondence axes (DIM). For numbers of the localities see the Appendix

Analysis of the body size (snout-vent length) of intraspecies group differences revealed that males from the former Yugoslav Republic of Macedonia (*T. v. graecus*) were statistically significantly smaller than the same sex of the other subspecies studied, including males from the intergradation zones (Scheffe's multiple t-test). Also, males from areas of subspecific hybridization were significantly smaller than *tomasinii* males. Concerning females, *T. v. meridionalis* were significantly larger than the other groups.

The first two canonical variates depicted accounted for 56% and 59% of the total dispersion in males and females, respectively. The pattern of character correlations between population variability and canonical variates was somewhat different between the sexes (Table 1). The first canonical variates appeared bipolar in both sexes; the distance between nostrils (In) and eyeball length (O) were opposed with the distance between fore and hind limbs (D). In addition, in females the variables In and O were contrasted with those of the other measured traits. Correlations of most measured traits with interpopulation variability on the second canonical variates were high and significant in both sexes. This suggests that discrimination between populations based on the second canonical variates may be caused by overall size.

Both in females and males only the majority of the *tomasinii* form and *T. v. graecus* (9 of 13, and 11 of 13, respectively) are grouped together with the highest value on both axes (Figs 4 and 5). These populations were discriminated

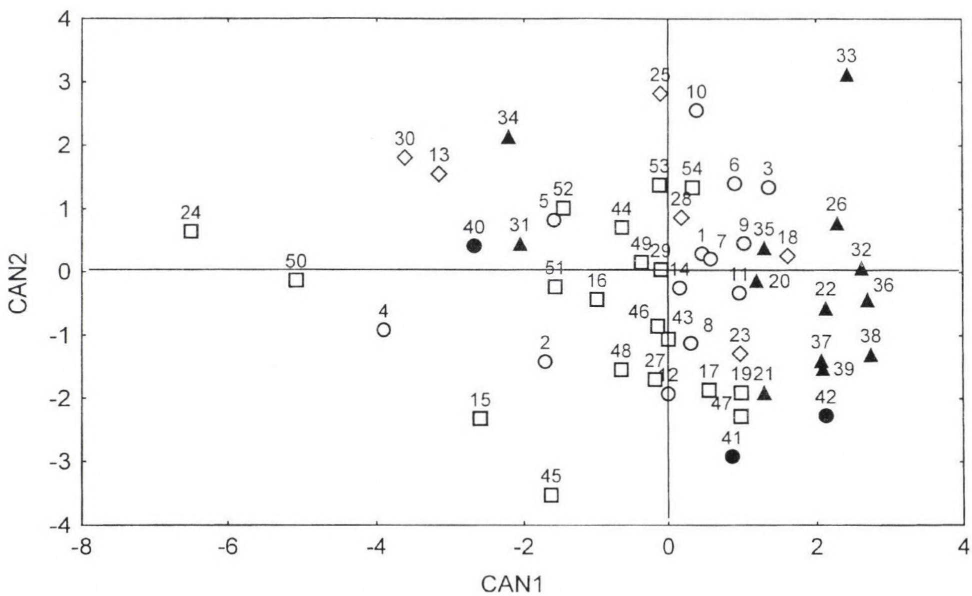
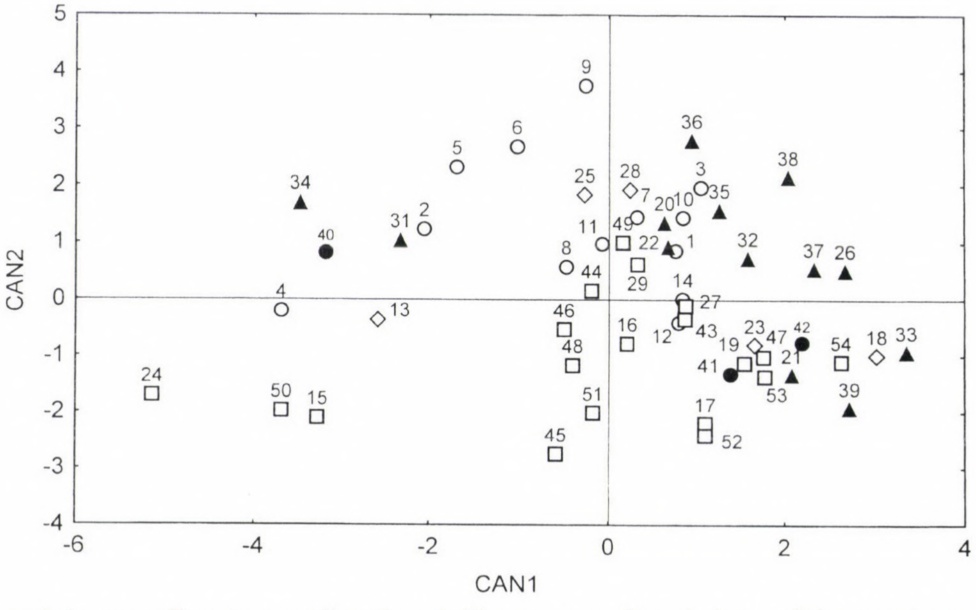


Fig. 4. Plots of populations centroids for males on the first and the second canonical axes (CAN). For numbers of the localities see the Appendix

Fig. 5. Plots of populations centroids for females on the first and the second canonical axes (CAN). For numbers of the localities see the Appendix



mainly according to nostril and eyeball measures. Populations of the nominate form and *T. v. meridionalis*, as well as those from intergradation zones were intermixed heavily in the morphometric space bordered by CAN1 and CAN2 axes.

DISCUSSION

The southern smooth newt subspecies distributed along the Adriatic coast from River Neretva to Montenegro was referred to *T. v. graecus* in the last decade (e. g. SCHMIDTLER & SCHMIDTLER 1983, BRUNO 1989, RAXWORTHY 1990, GRIFFITHS 1996) almost without exception. However, from our morphological analysis it appears that the smooth newt populations from southern Herzegovina and Montenegro, i.e. ranging from the River Neretva, the important zoogeographical boundary in the Balkans (see HADŽI 1935), to the so-called "Adriatic triangle", are somewhat different from *T. v. graecus* with respect to qualitative characters, and to a lesser extent to morphometric characters. This is especially obvious when two *T. v. graecus* populations (Nos 41, 42; Figs 2, 4 and 5) are considered. Our results reaffirmed the possibility of two separate groups of populations within the *T. v. graecus* subspecies range. The western one has been designated as the *tomasinii* form (WOLTERSTORFF 1908) with the *terra typica* of Tivat (Teodo di Cattaro, southern Montenegro), or even as a separate subspecies (MERTENS & MÜLLER 1940). The eastern one, *T. v. graecus* (sensu stricto) was

previously named as the *corcyrensis* form (WOLTERSTORFF 1908, see also WOLTERSTORFF 1912). A relevant matter for this issue is that the *tomasinii* form was considered to be a synonym of the subspecies *T. v. dalmaticus*, rather than of *T. v. graecus* (MERTENS & WERMUTH 1960). The southwestern "*graecus*", as we supposed, reaches the lowland and hilly terrain of Albania, as reported earlier by KOPSTEIN & WETTSTEIN (1920). The western "*graecus*" is certainly very close to *T. v. graecus*, as clearly shown by our study. Moreover, one of the *T. v. graecus* populations (Mount KoŽuf, No. 40) is well within the *tomasinii* group of populations (Fig. 2). Certainly our data are not conclusive in establishing *tomasinii* as a separate taxonomic unit (subspecies). Much more extensive *T. v. graecus* population sampling is needed to draw reliable conclusions. However, the results of our study do support the opinion that the "*graecus*" problem is not closed. We can now add additional proof in favour of this view. BOLKAY (1928) stated that the skull traits of individuals of the *tomasinii* form clearly differ from those of *T. v. graecus* individuals from Corfu Island. Also, smooth newt populations ranging from the River Neretva to Montenegro can be distinctly recognized from populations in the former Yugoslav Republic of Macedonia when comparing the phenotypes of the two gene loci (KALEZIC 1984).

We suppose that, besides the former Yugoslav Republic of Macedonia and Greece, the range of *T. v. graecus* also covers the eastern parts of Albania, and restricted areas of southern Serbia (along the rivers Drim, Pcinja and Lepenac). The valley of the Drim River might be the contact zone between western "*graecus*" (*tomasinii)* and eastern "*graecus*" *(T. v. graecus)*.

Smooth newt subspecies ranges in former Yugoslavia follow zoogeographical divisions to some extent, which has also been confirmed for the southern boundary of *T. v. meridionalis* that almost overlaps with the contact area between the Adriatic and Balkan subprovinces (HADŽI1931, SZYNDLAR 1984).

In this study two rather broad intergradation subspecies zones are well established, the first one being between *tomasinii* and *T. v. vulgaris*. Its most northwestern part includes the type locality of the previously described subspecies *T. v. dalmaticus* (KOLOMBATOVIC 1907). This zone penetrates rather deeply into the continental interior, reaching the Kupres plateau (No. 25), and the mountains of Zelengora (No. 28) and Žijovo (No. 30) (see Fig. 1). The second zone is situated between *T. v. meridionalis* and nominate subspecies. This zone covers the northwest contact between these subspecies (Fig. 1) as demonstrated earlier by electrophoretic data (KALEZIC 1984). The intergradation zone of western "*graecus*" and *T. v. vulgaris* subspecies is mostly localized in the Oromediterranean part of the Dinaric Alps, while the rest is in the Mediterranean and sub-Mediterranean zone. The intergradation zone of *T. v. meridionalis* and *T. v. vulgaris* is to a much lesser extent part of these distinct biogeographical entities (e.g. TRINAJSTIC 1977, MATVEJEV & PUNCER 1989). The intergradation zone bet-

ween *T. v. graecus* and *T. v. vulgaris* in Serbia has not been confirmed probably due to the lack of relevant population samples.

As claimed earlier by SCHMIDTLER & SCHMIDTLER (1983), we confirmed that *T. v. schreiberi* does not constitute an independent taxonomic unit. Individuals from the type locality of *schreiberi* (Ravni Kotari, No. 17) did not differ from the nominate smooth newts (Fig. 2). Interestingly, it seems that *T. v. vulgaris* from Ravni Kotari is separated from the rest of the smooth newt range by a narrow zone with the alpine newt (*Triturus alpestris*, KALEZIC *et al.* 1990). As far as we know it is the only case of fragmentation of the Balkan smooth newt range without morphological and genetical differentiation occurring at the same time. It seems that smooth newt populations from Ravni Kotari and the Dalmatian Zagora (Nos 17, 19, respectively) have recently been in contact with the rest of *T. v. vulgaris* through the large Dinaric karst fields, as well as along the valleys of the Sava River tributaries of the area in question. These were the old pathways of possible amphibian population communications in the Neogene, in terms of the distribution of water bodies and lands during the Miocene (KRSTIC 1996). Our statement seems to be supported by the fact that morphological traits of the Glamoc karst field specimens belong to the nominotype (No. 24, Figs 1 and 2). Unfortunately, only one male in breeding dressing was available from the locality in question. Its morphological traits were well within the *T. v. vulgaris* space bounded by the first two corresponding axes (Fig. 2), so it seems reasonable to suppose it belongs to the nominate subspecies. This population is probably a relict of the above-mentioned connection paths.

SCHMIDTLER and SCHMIDTLER (1983) suggested that the smooth newt populations in the Sava River valley differ morphologically from the rest of the nominotypical populations. We found that populations from the eastern Pannonian area (Vojvodina), including one across the Danube (No. 50) were grouped together on the same pole of *T. v. vulgaris* morphological variation pattern (Fig. 2). Nevertheless, it would be premature to consider eastern Pannonian populations as an independently evolving unit.

* * *

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Appendix
(Localities of populations, their altitudes, UTM code and the number of females + males collected)

1. Turjanci (Slovenia, 195 m above sea level, WM 86, 15 females + 15 males); 2. Podstrmec (Slovenia, 560 m, VL67, 12 + 21); 3. Svetvincenat (Croatia, 300 m, VK19, 42 + 55); 4. Istarske Toplice (Croatia, 20 m, VL12, 40 + 34); 5. Rijekan – Plosna (Croatia, 250 m, VL62, 19 + 26); 6. Rijeka – Lipa (Croatia, 520 m, VL43, 12 + 15); 7. Salakovci (Croatia, 320 m, VK38, 47 + 40); 8. Krk (Croatia, 30 m, VK68, 12 + 12); 9. Bag – Krk (Croatia, 175 m, VK87, 3 + 8); 10. Licki Osik (Croatia, 570 m, WK33, 41 + 26); 11. [vica (Croatia, 425 m, WK16, 19 + 11); 12. Smiljan (Croatia, 570 m, WK23, 28 + 24); 13. Bunic – Laudonov gaj (Croatia, 630 m, WK44/54, 34 + 58); 14. Karlovac (Croatia, 100 m, WL44, 17 + 15); 15. Orle (Croatia, 100 m, WL96, 20 + 27); 16. Jankovac (Croatia, 475m, YL04/14, 15 + 15); 17. Smilcic (Croatia, 190 m, WJ38, 19 + 15); 18. Otok – Sinjsko polje (Croatia, 295 m, XJ33, 27 + 21); 19. Umljanovic – Drniš (Croatia, 290 m, XJ04,47 + 28); 20. Pogana Vlaka – Donji Mamici (BiH, 330 m, XJ90, 15 + 12); 21. Norinska Kula – Metkovic (Croatia, 5 m, YH16, 33 + 19); 22. Domanovici (BiH, 160 m, YH27, 20 + 29); 23. Bosansko Grahovo (BiH, 795 m, XJ19, 27 + 21); 24. Karaizovci – Glamocko polje (BiH, 890 m, XJ56, 16 + 1); 25. [upljica – Kupres (BiH, 1350 m, XJ87, 35 + 25); 26. Sopilji – Nevesinjsko polje (BiH, 850 m, BP60, 47 + 3); 27. Jelah (BiH, 175 m, YK34, 32 + 24); 28. Gornje Bare – Zelengora (BiH, 1650 m, CP00, 15 + 16); 29. Zminje jezero – Durmitor (Montenegro, 1495 m, CN48, 30 + 27); 30. Bukumirsko jezero (Montenegro, 1440 m, CN71, 8 + 35); 31. Jezero – Lovcen (Montenegro, 1355 m, CM29, 32 + 31); 32. Tivatske solane (Montenegro, 5 m, CM19, 11 + 19); 33. Vilusi (Montenegro, 930 m, CN03, 10 + 86); 34. Spila – Voluje oko (Montenergo, 970 m, CN03, 53 + 18); 35. Osjecenica (Montenegro, 990 m, CN03, 17 + 15); 36. Balješina lokva – Orjen (Montenegro, 1330 m, BN91, 23 + 44); 37. Orahovacko polje – Virpazar (Montenegro, 5 m, CM47, 37 + 34); 38. Koštanjica (Montenegro, 290 m, CM56, 14 + 28); 39. Donji [toj (Montenegro, 0 m, CM54, 26 + 27); 40. KoŽuf (Former Yugoslav Republic of Macedonia, 1200 m, FL06, 26 + 7); 41. Bitolj (Former Yugoslav Republic of Macedonia, 580 m, EL24, 32 + 9); 42. Petralinci – Strumicko polje (Former Yugoslav Republic of Macedonia, 220 m, FL49, 19 + 13); 43. Sveti Ilija – Vranje (Serbia, 1120 m, EN61 , 36 + 34); 44. Vlasinsko jezero (Serbia, 1340 m, FN12/13, 17 + 21); 45. Belo Polje – Sukovo (Serbia, 420 m, FN36/46, 32 + 23); 46. Rtanj (Serbia, 620 m, EP74, 29 + 38); 47. Tutin (Serbia, 895 m, DN45/46, 19 + 31); 48. Sisevac (Serbia, 440 m, EP46, 25 + 25); 49. Bukovac – Valjevo (Serbia, 400 m, DP19, 25 + 36); 50. Trešnja (Serbia, 285 m, DQ63, 71 + 28); 51. Dobanovci (Serbia, 80 m, DQ36, 29 + 11); 52. Mutalj – Fruška Gora (Serbia, 200 m, CQ99, 15 + 15); 53. Svetozar Miletic (Serbia, 100 m, CR67, 15 + 10); 54. Banatsko Aranlelovo (Serbia, 80 m, DS40, 20 + 20).

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THREE RARE SPECIES OF PIPISTRELLUS (CHIROPTERA: VESPERTILIONIDAE) NEW TO VIETNAM

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Five species of Pipistrelle bat have recently been collected from the Socialist Republic of Vietnam. Three of these, *Pipistrellus cadornae*, *P. pulveratus* and *P. paterculus* are rare and have not previously been recorded from the country. The diagnostic characters, including bacula, are discussed for all five species. The baculum of *Pipistrellus cadornae* is described and illustrated for the first time and the systematic status of *P. paterculus* and *P. abramus* is reviewed. The high diversity of bats in Vietnam is briefly commented on.

Key words: Mammalia, Vespertilionidae, *Pipistrellus*, Vietnam, taxonomy

Recent research on bats in three separate localities in the Socialist Republic of Vietnam, Ba Be National Park, Cuc Phuong National Park and Na Hang Nature Reserve, included the collection of twelve specimens of *Pipistrellus*, representing five species. Three of these, *Pipistrellus cadornae* THOMAS 1916, *P. pulveratus* (PETERS, 1871) and *P. paterculus* THOMAS, 1915*a* are poorly represented in zoological collections worldwide and are included on List 3 (Lower risk: near threatened) in the 1996 IUCN Red List of Threatened Species (BAILLIE & GROOMBRIDGE 1996). None of these have previously been recorded from Vietnam. The other two, *Pipistrellus abramus* (TEMMINCK, 1840) and *P. tenuis* (TEMMINCK, 1840) are relatively common, both in Vietnam and elsewhere in southern and south-eastern Asia (CORBET & HILL 1992, BATES & HARRISON 1997).

To date, relatively little has been published specifically on the pipistrelle bats of Vietnam. BOURRET (1942, 1944) in his listing of mammal species from the region, included a series of pipistrelles from Vietnam which he tentatively referred to *Pipistrellus mimus* WROUGHTON, 1899 (considered by CORBET & HILL 1992 to be a junior synonym of *Pipistrellus tenuis*) and *P. coromandra* (GRAY, 1838). Later, TIEN (1966) collected a number of specimens which he referred to *Pipistrellus coromandrus tramatus* THOMAS, 1928. The taxon *tramatus* was subsequently included as a synonym of *Pipistrellus tenuis* by CORBET & HILL (1992), however, the measurements given by TIEN compare more favour-

ably with *Pipistrellus coromandra*. TOPÁL (1970, 1974) reported the results of two surveys in northern Vietnam (April–May, 1966 and November–December, 1971). He visited twelve localities, including Cuc Phuong National Park and collected six species of Vespertilionid bat, including one pipistrelle, *Pipistrellus abramus*. LEKAGUL & MCNEELY (1977) recorded five species of *Pipistrellus* from Thailand and suggested that two, *P. mimus* (*P. tenuis* sensu CORBET & HILL 1992) and *P. javanicus* (GRAY, 1838) also occurred in Vietnam. CORBET & HILL (1992) in the their comprehensive review of the mammal fauna of the region recorded four pipistrelle species from Vietnam, namely *Pipistrellus ceylonicus* (KELAART, 1852), *P. javanicus*, *P. abramus* and *P. tenuis*. KOOPMAN (1993) added *Pipistrellus coromandra* to the faunal list.

MATERIAL AND METHODS

In July–September 1994, members of the Society for Environmental Exploration, Vietnam in collaboration with the Institute of Ecology and Biological Resources, Hanoi undertook a survey of bats in Ba Be National Park in Cao Bang Province. Subsequently, in January–March 1996, they undertook a similar study in Na Hang Nature Reserve in Tuyen Quang Province. Both localities are in north-east Vietnam. Ba Be National Park covers an area of approximately 70 km^2 and is comprised of limestone mountains, rivers and lakes, ranging in altitude from 500 metres to 1098 metres; it is 157 km north of Hanoi and is centred on 22°26'N 105°38'E. Na Hang Nature Reserve is considerably larger at 217 km^2 and lies approximately 155 km north, north-west of Hanoi, between 22°16'N and 22°31'N and 105°22'E and 105°29'E. This reserve is mainly comprised of limestone hills, ranging in altitude from 300 metres to 1082 metres. It has numerous caves and is well drained by small rivers and streams. Bat specimens from both surveys were sent for identification to The Natural History Museum, London [formerly the British Museum (Natural History), BM(NH)]. The material included two specimens of *Pipistrellus pulveratus* from Ba Be National Park and a single specimen of *P. cadornae* from Na Hang Nature Reserve.

In May/June 1997, a survey of bats of Cuc Phuong National Park was undertaken by students from the National University of Hanoi and two British researchers, led by J. L. WALSTON. The park is situated 83 km south, south-west of Hanoi and is centred on 20°18'N 105°38'E. It is approximately oval in shape with a greatest length of 27.2 km and a greatest width of 10.3 km. A shallow valley runs through the middle of the park and spans its greatest length. The forest in Cuc Phuong is least disturbed along this valley and on the adjacent hills, whilst much of the peripheral forest close to the park's boundaries is highly degraded or lost. 95% of the ground area is at an altitude of 200 metres or less; it is covered by lowland semi-deciduous tropical rainforest growing almost entirely on limestone karst. The single site above 200 metres exhibits submontane closed broadleaved evergreen forest. Generally there is little variation in habitat types, with some 70% of the park's 220 km^2 land area under forest, although virtually none remains pristine. Most of the watercourses are seasonal. Only one river, the Song Buoi, is permanent; it runs through the extreme north-west of the park. The karst geology of Cuc Phuong has resulted in a complex network of subterranean rivers, sinkholes and caves providing ideal roosting sites for bats. Using mistnets and hand-held butterfly nets, fifty voucher specimens were collected and deposited at the Harrison Zoological Museum (HZM) for identification. Thirty-five species belonging to eight families were identified, including nine specimens of *Pipistrellus* referable to five species.

All specimens are currently preserved in 70% ethyl-alcohol, with the skulls extracted and prepared. Standard external measurements were taken from the spirit specimens prior to their preparation. The additional external and cranial measurements were taken after preparation with elec-

tronic calipers accurate to 0.01 mm. The abbreviations and method of measurement follow BATES & HARRISON (1997). The bacula of the five male pipistrelle specimens were prepared following the method outlined in THOMAS *et al.* (1994). The penis was dissected from the body; it was subsequently placed in a test tube and lightly boiled in water for about three to four minutes. The water was drained and the penis left in a small container for 24 hours to macerate in a solution of 5% potassium hydroxide and alizarin red. The soft tissue was then removed by manual dissection leaving the stained baculum. The bacula were stored in glycerol. The illustrations of the bacula and dentition were drawn (by DLH) using a Wild-Heerbrugg stereo microscope and attached camera lucida. All specimens from Cuc Phuong are housed in the Harrison Zoological Museum, Sevenoaks, UK; those from Ba Be National Park and Na Hang Nature Reserve are in The Natural History Museum, London.

RESULTS

Pipistrellus cadornae THOMAS, 1916

Pipistrellus cadornae THOMAS, 1916: 416; Pashok, 3500 ft, Darjeeling, north-eastern India. – Thomas's Pipistrelle

Vietnam: Cuc Phuong National Park, HZM.1.30538 (female); Na Hang Nature Reserve, BM(NH) 1997.375 (male): [measurements listed in Table 1]

Diagnostic description: The dorsal pelage is soft, dense and long. The hair tips are chestnut brown with the roots slightly darker. On the ventral surface, the hair tips are a paler chestnut brown and the roots dark brown. The ears are characteristically large; they are broad and with a rounded tip. The tragus of each ear is less than half the height of the pinna; it is also broad with a concave anterior surface and convex posterior one. The penis is robust but not as enlarged as that of *Pipistrellus abramus* or *P. paterculus*. The baculum (Fig. 1), which has not previously been described or illustrated (HILL & HARRISON 1987), is small (2.5 mm) but with a relatively robust base that is expanded both dorso-ventrally and laterally. The shaft is curved downwards in lateral view and is deeply grooved ventrally; the groove extends backwards between two pronounced ventral projections on each side of the base. The distal end is distinctively spoon-shaped, projecting ventrally; it is deeply concave on its ventral aspect; its dorsal aspect is distinct from the shaft, with elevated edges and a shallow central concavity. In the skull, the rostrum is not especially broadened and not greatly angulated inwards posteriorly; the nasal notch is large and rounded. The braincase is narrow, rounded and not flattened; there is a very shallow sagittal crest in its midpart; this is less evident in specimen BM(NH) 1997.375. The cranial profile is essentially straight from the nares to the lambda without a frontal depression between the braincase and the rostrum. The zygomata are relatively robust with a well defined dorsal process on each jugal bone. The basisphenoid pits are large and deep. The first upper incisor (i^2) is short and broad and has a distinct secondary cusp which

nearly attains the primary cusp in height. The second incisor (i^3) is relatively large, with a secondary cingular cusp internal to the principal one; there is also an external one in specimen HZM.1.30538. The upper canine is without a secondary cusp (Fig. 2). The first upper premolar (pm^2) is very small, about half to two thirds the crown area of i^2, less than half that of i^3; it is situated in the recess formed by the upper canine and the second upper premolar (pm^4) which are nearly in contact; it is obscured or partially obscured when viewed externally. The first lower premolar (pm_2) is situated in the toothrow; it is between half and two-thirds the crown area and half the height of the second lower premolar (pm_4).

Taxonomic remarks: the taxon *cadornae* was listed as a provisional subspecies of *Pipistrellus savii* (BONAPARTE, 1837) by ELLERMAN & MORRISON-SCOTT (1951) but following HILL (1962) was subsequently treated as a distinct species. It differs from *P. savii* in its relatively tall, not flattened braincase and its deep basisphenoid pits, in *P. savii* the pits are scarcely present. The baculum is also strikingly different. In *P. savii*, the distal end of the baculum is more robust than the base and is transversely expanded, without a dorsal or ventral concavity

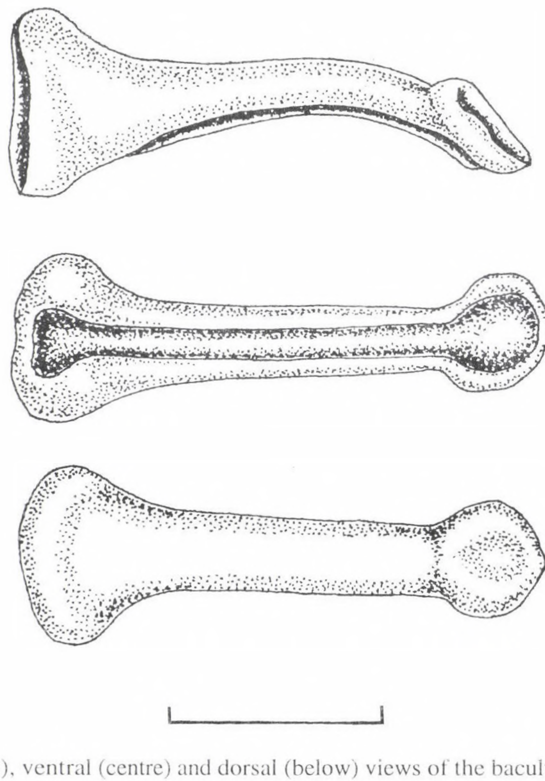


Fig. 1. Lateral (above), ventral (centre) and dorsal (below) views of the baculum of *Pipistrellus cadornae*, BM(NH) 1997.375, Na Hang Nature Reserve, Vietnam. Scale = 1 mm

(HILL & HARRISON 1987). The baculum of *P. cadornae* shows some similarity to that of *Pipistrellus kitcheneri* THOMAS, 1915*b* described from Borneo. However, that of *P. kitcheneri* differs in having a distal expansion with two small projections which are directed posteriorly and in having a dorsal groove which extends along the shaft for more than half its length (HILL & HARRISON 1987). CORBET & HILL (1992) placed *P. cadornae* and *P. kitcheneri* in the *Pipistrellus lophurus* subgroup, together with *P. lophurus* THOMAS, 1915*c*, which was described from southern Myanmar. It is interesting to note therefore that the baculum of *P. lophurus* also shows some similarities to *P. cadornae*, with a dorso-ventrally and laterally expanded base and a downturned spatulate tip (HILL & HARRISON 1987). The evidence of the baculum therefore suggests that *P. cadornae* is more closely related to *P. kitcheneri* and *P. lophurus* than *P. savii*.

Distribution: Cuc Phuong National Park and Na Hang Nature Reserve are the first known records for Vietnam. Previous records are restricted to four isolated localities in India and Myanmar (BATES & HARRISON 1997) and Petchabun (approx. 16°42'N 100°48'E) in northern Thailand (HILL & THONGLONGYA 1972).

Ecological notes: The female specimen (HZM.1.30538) was caught at 20.40 hours on 24 May 1997 flying low over a stagnant swimming pool adjacent to the Cuc Phuong National Park headquarters. The vegetation in this area is disturbed semi-deciduous forest.

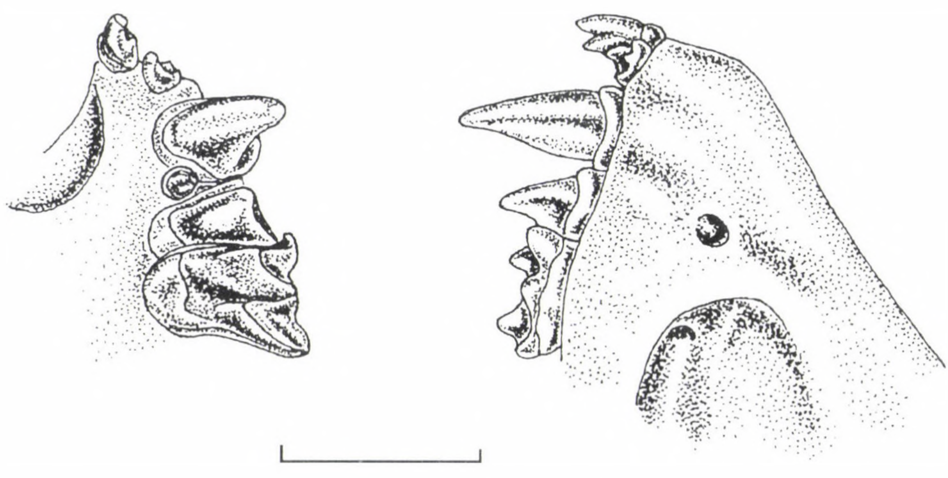


Fig. 2. Lateral (above) and occlusal (below) views of left anterior dentition (i^2-pm^4) of *Pipistrellus cadornae*, HZM.1.30538, Cuc Phuong National Park, Vietnam. Scale = 2 mm

Table 1. External and cranial measurements (in mm) of twelve specimens of *Pipistrellus* from Ba Be National Park, Cuc Phuong National Park and Na Hang Nature Reserve, Vietnam

	P. cadornae		*P. pulveratus*				*P. paterculus*			*P. abramus*		*P. tenuis*
HZM no.		1.30538	3.30701	4.30705			4.30714	1.30700*	2.30703*	3.30704	6.30715*	5.30702
BMNH no.	1997.375				1997.330	1997.331						
Sex	male	female	female	male	female	female	male	female	female	male	female	male
HB	46.6	44.1	41.8	47.6	43.0	43.8	–	39.2	44.8	38.4	36.0	42.1
T	34.3	32.1	33.3	32.6	37.0	36.5	–	31.4	26.4	31.2	34.9	31.2
HF	7.0	5.9	6.8	6.2	7.0	6.4	5.9	6.3	5.2	4.5	4.5	4.2
TIB	15.0	15.6	15.1	14.1	14.9	14.8	12.2	12.5	11.7	12.6	12.9	12.1
FA	33.0	36.6	35.8	35.9	34.6	34.0	31.4	31.5	30.4	30.9	31.2	30.3
5MET	30.9	32.8	32.5	31.3	32.0	32.1	28.9	30.0	28.6	28.5	28.9	28.2
4MET	31.7	33.4	34.2	32.2	32.8	33.8	29.5	30.4	28.6	29.4	30.5	28.6
3MET	32.7	33.8	33.9	33.0	33.3	34.0	29.1	30.6	28.9	29.2	30.0	28.5
E	14.1	12.4	14.4	13.8	13.8	13.7	8.7	9.7	9.3	9.4	7.8	9.5
GTL	13.4	13.6	14.3	14.1	14.2	13.9	–	12.5	12.5	12.6	12.4	12.2
CCL	12.5	12.7	13.0	12.6	12.8	12.6	–	–	11.1	11.0	10.9	10.7
ZB	8.4	8.6	8.6	8.3	8.6	8.4	–	–	8.2	8.0	–	–
BB	6.9	6.7	6.7	6.8	6.7	6.7	–	6.7	6.2	6.4	6.5	6.3
PC	3.8	3.5	3.6	3.6	3.8	3.6	–	3.9	3.5	3.6	3.5	3.3
$C–M^3$	4.7	4.9	5.1	4.9	4.8	4.9	4.4	4.4	4.4	4.2	4.3	4.2
$C–M^3$	4.8	4.9	5.2	5.2	5.0	5.1	4.8	4.5	4.5	4.4	4.6	4.6
$M^3–M^3$	5.7	6.0	6.1	5.9	5.9	5.8	–	5.4	5.8	5.2	5.3	5.0
M	9.8	9.8	10.0	9.8	10.0	–	9.2	9.1	8.7	8.6	9.0	8.6
RW	5.1	5.3	5.4	5.3	5.4	5.4	–	5.0	4.9	4.9	4.5	4.4

*: female specimens tentatively referred to their respective species (see text)

Measurements (after BATES & HARRISON, 1997): HB: head and body; T: tail; HF: foot; TIB: tibia; FA: forearm; 5MET: fifth metacarpal; 4MET: fourth metacarpal; 3MET: third metacarpal; E: ear; GTL: greatest length of skull; CCL: condylo–canine length; ZB: zygomatic breadth; BB: breadth of braincase; PC: postorbital constriction; $C–M^3$: maxillary toothrow length; $C–M_3$: mandibular toothrow length; $M^3–M^3$: posterior palatal width – outer border of M^3s; M: mandible length; RW: rostral width

Pipistrellus pulveratus (PETERS, 1871)

Vesperugo pulveratus PETERS, 1871: 618; Amoy, Fujian, China. – Chinese Pipistrelle

Vietnam: Ba Be National Park, BM(NH) 1997.330–331 (females); Cuc Phuong National Park, HZM.4.30705 (male) and HZM.3.30701 (female): [measurements listed in Table 1].

Diagnostic description: The dorsal pelage is long, thick and silky. It is essentially black but the hairs are tipped with golden-brown. On the ventral surface, the hair roots are very dark; the tips are a pale buffy-brown. The ears are characteristically very tall but not as broad as those of *P. cadornae*. The tragus of each ear is broad; it has a straight anterior margin and a convex posterior one and is about one third the height of the pinna. The penis is of moderate size. The baculum is relatively short (2.4 mm). It has a broad shaft that is smooth dorsally but hollowed out below. The tip is blunt and the base simple, not bilobate (Fig. 3). In the skull, the rostrum is long, relatively narrow and with a shallow median rostral

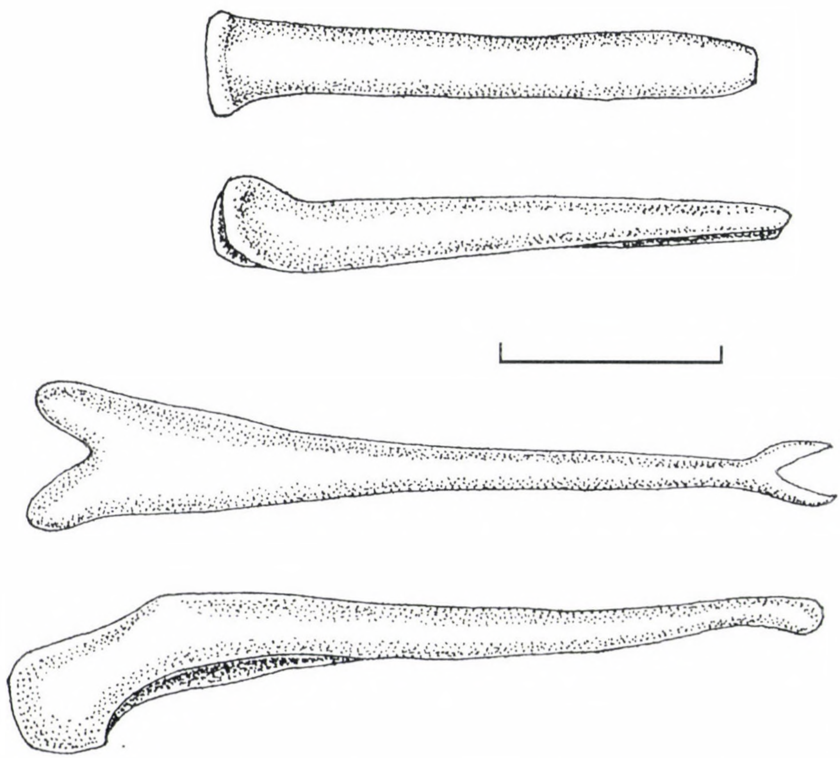


Fig. 3. Dorsal (above) and lateral (below) views of the bacula of two species of *Pipistrellus*. a: *P. pulveratus*, HZM.4.30705, Cuc Phuong National Park, Vietnam. b: *P. tenuis*, HZM.5.30702, Cuc Phuong National Park, Vietnam. Scale = 1 mm

depression; there are shallow lateral depressions above the anterior margin of each orbit. The braincase is elongated and inflated, especially anteriorly; the supraoccipital is bulbous and forms the most posterior part of the skull; there is a shallow depression at the fronto-parietal suture. The sagittal crest is absent or very shallow. In lateral profile, there is a marked frontal depression; the anterior part of the rostrum is tilted upwards. The zygomata have a short dorsal process on each jugal bone in some specimens. The basioccipital has a well defined central ridge running between the two cochleae but the basisphenoid pits are virtually absent. The first upper incisor (i^2) is robust, short and broad and has a distinct secondary cusp which attains two thirds the height of the primary one. The second incisor (i^3) is relatively large, with a secondary cusp internal to the principal one. The upper canine is without a secondary cusp. The first upper premolar (pm^2) is relatively tall but its crown area is usually about two thirds or equal to that of i^2; it is situated in the recess formed by the upper canine and the second upper premolar (pm^4) which are in contact; it is obscured or partially obscured when viewed externally. The first lower premolar (pm_2) is situated in the toothrow; it is between half and two thirds the crown area and half the height of the second lower premolar (pm_4).

Taxonomic remarks: The distinctive shape of the baculum clearly distinguishes males of this taxon from similar sized pipistrelles such as *Pipistrellus javanicus*. However, in the case of females, the identification of specimens is more difficult as the differences in the cranial and dental morphology between *P. pulveratus* and *P. javanicus* are sometimes indeterminate, although in general the pm^2 of *P. javanicus* averages larger than that of *P. pulveratus*. However, the thick, long silky almost black dorsal pelage, with its frosting of golden-brown tips distinguishes *P. pulveratus* from the paler, chestnut, occasionally clove brown pelage of *P. javanicus*. A description of the karyotype (2n= 44, FN= 55/56) of this rare bat, based on specimens from Thailand, is given in HARADA *et al.* (1985).

Distribution: Ba Be National Park and Cuc Phuong National Park are the first known records for Vietnam. Elsewhere it is widespread but little known in southern China (ALLEN 1938) where records include the provinces of Yunnan, Sichuan, Hunan, Jiangxi, Fujian, Hong Kong and Hainan Island (CORBET & HILL 1992); also Lopburi (14°49'N 100°36'E) in central Thailand (LEKAGUL & MCNEELY 1977).

Ecological notes: Both specimens from Cuc Phuong National Park were caught in mist nets placed across the entrance to the Cave of Early Man. This cave, situated in the south-central part of the park, is one of the main tourist sites of Cuc Phuong. There is considerable human disturbance, including shouting, the throwing of sticks and rocks and the burning of incense within the cave. However, some 19 species of mega- and microbat were collected at the two entrances

to the cave and many of these bats roost within the cave complex (J. L. WALSTON personal observation). The two *P. pulveratus* specimens were collected at 19.20 and 20.50 hours on 10 May 1997. Their roost was not located. The area in front of the cave is highly disturbed semi-deciduous forest.

Pipistrellus paterculus THOMAS, 1915

Pipistrellus paterculus THOMAS, 1915a: 32; Mount Popa, Upper Burma (Myanmar). – Mount Popa Pipistrelle

Vietnam: Cuc Phuong National Park, HZM.4.30714 (male) and two female specimens that are tentatively referred to this taxon: HZM.1.30700 and HZM.2.30703 (measurements listed in Table 1).

Description: The hairs on the dorsal surface are dark chocolate brown throughout their length with the roots scarcely differentiated from the tips. On the ventral surface, the hair bases are also dark but the tips are a paler ginger brown. The head of the male specimen was damaged and therefore it is not possible to determine the size and shape of the ears. However, those of the referred female specimens are short and of moderate width. The tragus of each ear is well developed and moderately broad, with an essentially straight anterior margin and a convex posterior one. The penis is unusually large, although comparable in size to that of *P. abramus*. The baculum is diagnostic; it is very long (11.6 mm) with a narrow shaft and a strongly bifid tip, the horns of which are deflected ventrally (Fig. 4). The skull of HZM.4.30714 is badly damaged. The rostrum is short, its breadth is indeterminate. In lateral profile, there appears to be concavity where the posterior part of the rostrum meets the anterior part of the braincase. The ventral aspect of the braincase including the mastoid and basioccipital region is entirely absent. However, the mandible, including its dentition and the left maxillary dentition are complete. The first upper incisor (i^2) is bicuspid, the second (i^3) attains the height of the secondary cusp of i^2. The posterior cutting edge of the canine is without a secondary cusp. The first upper premolar (pm^2) is small but not minute, it is variably intruded in the toothrow and is about equal in crown area to i^2. The canine and second upper premolar (pm^4) are closely adjacent but not in contact. In the mandibular dentition, the first premolar (pm_2) is subequal in crown area and three quarters the height of the second premolar (pm_4).

Taxonomic remarks: the taxon *paterculus* was listed as a possible subspecies of *P. abramus* by ELLERMAN & MORRISON-SCOTT (1951). However, HILL & HARRISON (1987) supported the view of THOMAS (1915*a*) that the baculum of *paterculus* is straight or nearly so whilst that of *abramus* has a characteristic double curve when viewed laterally. The finding of *P. paterculus* and *P. abramus* sympatrically within Cuc Phuong National Park confirms THOMAS's orig-

inal view that the two are specifically distinct. However, the present authors found that it was not possible to distinguish with certainty between females of the two taxa; the dental characters (relative size of the upper incisors and the small upper premolar) listed in DAS & SINHA (1995) do not appear to be consistent and there do not appear to be significant differences in size.

Distribution: Cuc Phuong National Park is the first known record for Vietnam. Elsewhere it has a geographically widespread distribution but is little known. It is recorded from India, Myanmar (BATES & HARRISON 1997), southern China (CORBET & HILL 1992) and Thailand (KOOPMAN 1993). Specimens from Pakistan, previously referred to this species by ROBERTS (1977) are now assigned to *P. pipistrellus* (BATES & HARRISON 1997).

Ecological notes: The male specimen (HZM.4.30714) was picked up dead (in July 1997) off the road that runs along the floor of the valley through the centre of Cuc Phuong National Park; it was approximately 2 km from the park headquarters. A female (HZM.1.30700) was collected in a mistnet at 23.10 hours on 23 May 1995 near this road – some 6 km from the park headquarters and 1 km from the Cave of Early Man. This latter area had an exceptionally rich bat fauna

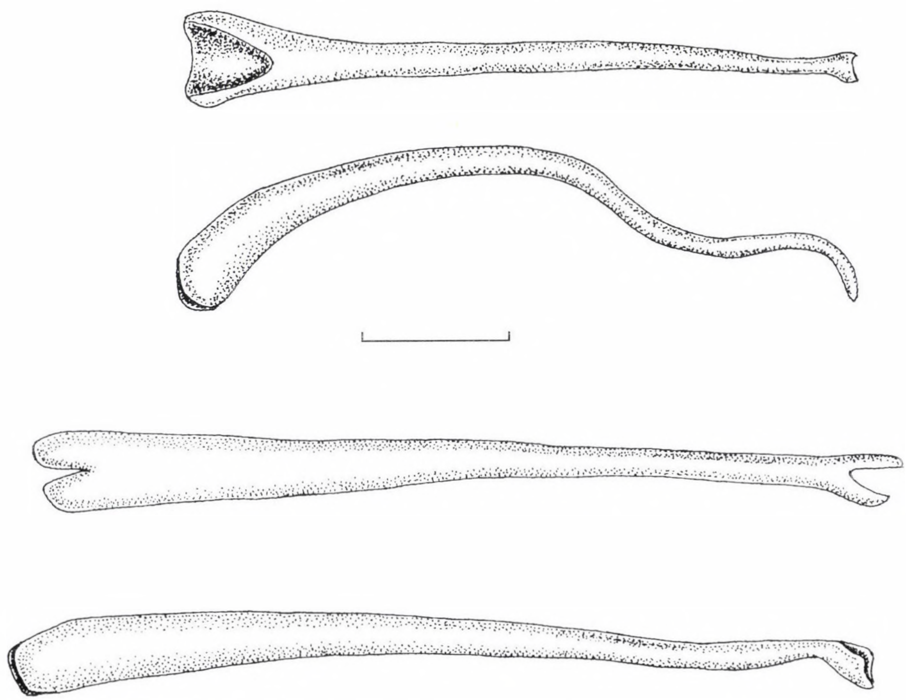


Fig. 4. Dorsal (above) and lateral (below) views of the bacula of two species of *Pipistrellus*. a: *P. abramus*, HZM.3.30704, Cuc Phuong National Park, Vietnam. b: *P. paterculus*, HZM.4.30714, Cuc Phuong National Park, Vietnam. Scale = 2 mm

for an open site; other species collected included *Myotis chinensis, Miniopterus schreibersii, Hipposideros larvatus, Hipposideros turpis* and *Scotomanes ornatus*. The general habitat of this flat bottomed valley was open semi-deciduous forest interspersed with a series of small streams and pools. The third specimen from Cuc Phuong (HZM.2.30703) was caught in a mistnet at 21.20 hours on 27 May 1997 over the swimming pool adjacent to the park headquarters (for description of area see *P. cadornae*).

Pipistrellus abramus (TEMMINCK, 1840)

Vespertilio abramus TEMMINCK, 1840: 232, pl. 58; Nagasaki, Kyushu, Japan. – Japanese Pipistrelle

Vietnam: Cuc Phuong National Park, HZM.3.30704 (male); a female specimen HZM.6.30715 is also tentatively referred to this taxon (measurements listed in Table 1)

Description: The dorsal pelage has grey-brown hair tips, with the roots darker. On the ventral surface, the tips are light brown with the roots contrastingly dark. The ears are short and relatively broad; they have simple rounded tips. The tragus of each ear is comparable to that of *P. paterculus*. As in *P. paterculus*, the penis is very large. The baculum is long (8.9 mm), thin and sinuous with a characteristic double curve when viewed laterally (Fig. 4). The base is slightly bilobate and the tip bifid. In the skull, the rostrum is short, moderately broad and with a very shallow median depression. The nasal notch is long, V-shaped but with a slightly rounded base. The postorbital constriction is not significantly narrower than the rostrum. The braincase is short, broad and moderately inflated. The supraoccipital forms the most posterior part of the skull. In lateral profile, there is a slight depression in the interorbital region. The lambda forms the most elevated part of the skull. The basioccipital has a well defined central ridge running between the two cochleae but the basisphenoid pits are virtually absent. The first upper incisor (i^2) has a well defined secondary cusp that is about two thirds the height of the primary one. The second incisor (i^3) is equal in height to the secondary cusp of i^2. The upper canine is tall and narrow, with an incipient posterior secondary cusp at about one third the height of the principal one. The first upper premolar (pm^2) is displaced internally in the toothrow. It has a simple conical cusp and a crown area sub-equal to i^3; it is partially visible when the toothrow is viewed laterally. The canine and the second premolar (pm^4) are not in contact. In the mandibular dentition, the first premolar (pm_2) is about three quarters the crown area and height of the second (pm_4).

Taxonomic remarks: KOOPMAN (1993) included *abramus* as a synonym of *P. javanicus*; this view ignored the very different bacula of the two taxa (HILL & HARRISON 1987) and is not followed here. A description of the distinctive ka-

ryotype of *P. abramus* (2n= 26, FN= 44) from Japan is included in ANDO *et al.* (1987). For the relationship and difficulties in distinguishing between females of *P. abramus* and *P. paterculus*, see above.

Distribution: according to CORBET & HILL (1992), it is widespread in northern Vietnam, China, Taiwan and Japan. Recent records from India and Myanmar are included in DAS & SINHA (1995).

Ecological notes: The male specimen (HZM.3.30704) was caught on 5 June 1997 at 19.30 hours in a mistnet set over a stream in open farmland. This was the site of a former village inside Cuc Phuong National Park which had subsequently been relocated. The area is flat and dominated by grasses, although there are some trees on the banks of the stream. This location is about 3 km from the park's headquarters. The female specimen (HZM.6.30715) was collected in a degraded forest, some 50 metres from the Buoi river.

Pipistrellus tenuis (TEMMINCK, 1840)

Vespertilio tenuis TEMMINCK, 1840: 229; Sumatra, Indonesia. – Least Pipistrelle

Vietnam: Cuc Phuong National Park, HZM.5.30702 (subadult, male): [measurements listed in Table 1].

Description: The pelage is a uniform dark clove brown on the dorsal surface. The hairs on the ventral surface have paler brown tips and dark roots. The ears are small and moderately broad. The tragus of each ear is small, with a concave anterior border and a convex posterior one. The penis is of moderate size. The baculum has a thin shaft of moderate length (3.7 mm) and a distinctly bifid tip; the basal lobes are well developed and deflected ventrally (Fig. 3). In the skull, the rostrum is relatively narrower than that of specimens referred to *P. paterculus* and *P. abramus*; there is a shallow median depression and the nasal notch is V-shaped. The braincase appears somewhat flattened in comparison to *P. abramus* and in lateral profile, there is an almost straight line from the nares to the lambda. The basioccipital has a well defined central ridge running between the two cochleae but the basisphenoid pits are shallow. The first upper incisor (i^2) is bicuspidate with the secondary cusp about half the height of the principal one. The second incisor (i^3) exceeds the secondary cusp of i^2 in height. The upper canine has a distinct posterior secondary cusp. The first upper premolar (pm^2) is intruded from the toothrow; it is about equal in crown area to i^2. The canine and second upper premolar (pm^4) are not in contact but are closely adjacent. In the mandibular dentition, the first premolar (pm_2) is slightly extruded from the toothrow; it is three-quarters the crown area and about two thirds the height of the second premolar (pm_4).

Taxonomic remarks: here following CORBET & HILL (1992), the taxa *tenuis* and *mimus* are considered to be conspecific. This view is contrary to KOOPMAN (1993).

Distribution: according to CORBET & HILL (1992), it is found throughout most of Vietnam; elsewhere it is known from Afghanistan through Pakistan, India, Nepal, Bangladesh to Myanmar (BATES & HARRISON 1997) to south-east Asia, including Indonesia, Philippines and possibly northern Australia (CORBET & HILL 1992).

Ecological notes: The single subadult specimen (HZM.5.30702) was collected over the dry riverbed of the Buoi river, adjacent to a village.

DISCUSSION

Indochina, considered here to be the geographical region of Vietnam, Laos, Cambodia, Hainan and Yunnan, consists of a highly complex mosaic of biogeographical subregions that are poorly understood. Recent bird studies (ROBSON *et al.* 1989, 1993) and high-profile discoveries of large mammals in the Annamite mountains (DUNG 1993, TUOC 1994) have underscored two basic points. The first is that the region boasts an extraordinary level of species richness, even though biological research is far from complete. The second is that it is home to many species with primitive characteristics for their group and that the region is likely to contain a number of centres of endemism. A recent bird study identified four such centres: the Annamese lowlands, the Da Lat Plateau, Cochin China and Hainan (ICBP 1992). However, much of the recent research and interest has remained focused on new high profile species and other possible flagship species for conservation. To date, scant regard has been given to more diverse groups such as small mammals, the herpetofauna and invertebrates.

The recent survey in Cuc Phuong operated with the minimum of sophisticated equipment. However, it has already shown that in Vietnam even a relatively small national park such as Cuc Phuong (less than 220 km^2) is home to some 3.5% of the world's bat species. Further intensive survey work would probably produce a higher figure, possibly in the region of 5%. This compares to just 2.9% for the whole of Sri Lanka, with a land area of 65610 km^2, about 300 times that of Cuc Phuong, and with an altitudinal range of 0–2524 metres and a rich variety of habitat types. Sri Lanka itself is considered an area of rich biodiversity within southern Asia (GREEN & GUNAWARDENA 1993).

Three of the species of *Pipistrellus* described here have not previously been recorded from Vietnam. They are all rare and are listed as conservation priorities by BAILLIE & GROOMBRIDGE (1996). As such, Vietnam must be considered a priority area for bat research and conservation. However, Vietnam is losing its

last natural forest cover for various human-related reasons, and with it, probably a large number of undescribed taxa. Bats are especially vulnerable in Vietnam, since less than 12% of the country is now covered by closed tropical forest and with less than 1% in pristine condition (COLLINS *et al.* 1991). In addition, the vast networks of caves throughout the country, ideal sites for roosting, are being destroyed through blasting for rock and minerals. It is essential that further baseline work is undertaken in Vietnam to enable the government and conservationists to justify and prioritise efforts to protect the country's remaining natural habitats.

* * *

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A NEW MOUSE-EARED BAT SPECIES, FROM NEPAL, WITH STATISTICAL ANALYSES OF SOME OTHER SPECIES OF SUBGENUS LEUCONOE (CHIROPTERA, VESPERTILIONIDAE)

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A description of a new bat species *Myotis csorbai* sp. n., from Nepal, related to *Myotis longipes* (DOBSON, 1872) is given. Results of statistical analyses, along with those on samples from Kashmiri and Afghan populations of the other species and on some other members of the *Leuconoe* subgenus are presented.

Key words: Mammalia, Vespertilionidae, *Myotis*, *Leuconoe*, Nepal, taxonomy, systematics

INTRODUCTION

The species *Myotis longipes*, a member of the subgenus *Leuconoe*, has been known from Kashmir for almost one and a half centuries. BLYTH's *M. theobaldi* (1856) was probably the first name which referred to this fairly small-sized mouse-eared bat from the vicinity of Islamabad (CORBET & HILL 1992). The same authors (CORBET & HILL op. cit.) reviewed the synonymy, taxonomy, as well as the known distribution data of the species. KOOPMAN (1993) did not mention any subspecies of *Myotis longipes* and recorded it only from Afghanistan and Kashmir. SINHA (1994) also mentioned the species from Siju Cave, Meghalaya. GAISLER (1970*b*) treated *Myotis longipes* as "nearly endemic or endemic" to Afghanistan, with a small range in the border between the Palaearctic and the Oriental Regions. OSGOOD's (1932) record from Vietnam was based most probably on a misidentification of *M. laniger*. FINDLEY (1972), as a result of his numerical taxonomical work based both on external and craniological features, found clear proof for its membership of the *daubentoni–capaccinii* group within the subgenus *Leuconoe*.

The uncertainty about the systematics of the *daubentoni–capaccinii* group and its Palaearctic and Oriental members has appeared in all major and comprehensive works (TATE 1941, ELLERMANN & MORRISON-SCOTT 1951, CORBET 1978, CORBET & HILL 1992).

Besides the closely related *M. longipes*, other members of the *daubentoni–capaccinii* group: the well-known *M. daubentoni* and *M. capaccinii*, and the

much less studied and therefore systematically uncertain species *M. laniger* (CORBET & HILL op. cit.) were used here for comparisons.

Description of a medium sized sample, two adult males and eight adult females of a new species of *Myotis* from Nepal is given below. The specimens from the type locality are also listed by BATES and HARRISON (1997) but as *M. longipes*.

MATERIAL AND METHODS

External measurements (forearm length and tibia length) of 51, as well as cranial and mandibular measurements of 46 adult specimens of *M. longipes* deposited in the Mammal Collection of the Hungarian Natural History Museum, Budapest were used. The material from a population estimated to number about four thousand, was collected by the present author the Bumzov Cave, at about 2000 m a.s.l. on the north-south route between Pahalgam and Anantnag, Kashmir, India, on 9 June, 1967. According to KOUL (1965, p. 51), an earlier name for Anantnag was Islamabad. Thus, the type locality could be close by or even at the same place as for the present material. The shortest distance between the currently well-known Islamabad, N of Rawalpindi, Pakistan and Anantnag is about 200 kilometres, and the one between Anantnag and the localities of *M. csorbai* sp. n. in Nepal is about 1040 km to the southeast of Anantnag. Specimens of more than 37 percent of the Bumzov population had some irregularly placed small albinotic spots of various extension on the upper as well as on the under part of their pelage.

The mandible and the badly damaged skull of an alcoholic specimen, ZMB 4864, in the Zoological Museum of Humboldt University Berlin, with locality "Ost-Indien" and collected by JERDON was also included in the present study. It is worth noting that the specimen had the same peculiar albinism, as was mentioned for the Bumzov population.

Mandibular and cranial measurements of the No 76.3.10.4. male cotype specimen of *M. longipes* from the Caves of Bhima Devi, Kashmir, deposited in The Natural History Museum, London were also included, along with those of five other specimens also stored there: 68.458 male, 68.460 male, 68.466 female, 68.471 male and 68.472 female collected in Afghanistan on 18 April, 1967 and presented by J. GAISLER (see GAISLER 1970*a*).

For some analyses the cranial and mandibular measurements of 34 and 36 specimens of *M. daubentoni* were used, respectively, mostly from Hungary and partly from other European countries, deposited in the Mammal Collection of Hungarian Natural History Museum.

In total 12 specimens of *Myotis laniger* were studied, including specimen number ZMB 4146, Amoy, China, the holotype of the species deposited in the Museum of the Humboldt University, Berlin. Three specimens, HNHM 92.108.1. female, HNHM 92.108.2. male, HNHM 92.108.3. male were from near Cherrapunjee, Meghalaya, India, HNHM 93.57.1. female came from Ta Phinh, North Vietnam (all four collected by the author and deposited in the Mammal Collection of Hungarian Natural History Museum). In addition to the above holotype, there are also two more specimens deposited in the Museum of Humboldt University, Berlin: a female with no registration number from Macao, China and a male ZMB 43312 from Kwantung, China, all of which had the almost complete set of measurements. The following specimens had been studied earlier by taking fewer measurements: a female 1948–371 (MA 283) Binh-du, Chapa, N Vietnam, in the Muséum National d'Histoire Naturelle, Paris, ZMB 54087 sex?, ZMB 54158 female, ZMB 54161 female, all from Tonkin and ZMB 54162 unknown sex from Annam, all in the Berlin collection.

Sixty *Myotis capaccinii* (45 from northern Yugoslavia, Dalmatia and Macedonia, 15 from Iraq) deposited in the Mammal Collection of Hungarian Natural History Museum, Budapest were also included for cranial and mandibular data analyses.

Two external measurements (forearm length and tibia length, taken in the field by a caliper up to 0.1 mm accuracy) were analysed for a comparison of the Kashmiri *M. longipes* and Nepalese

M. csorbai sp. n. samples. Forty-nine cranial and 35 mandibular characters were measured. The characters, with their definitions where necessary, are listed in Tables 2 and 3. Measurements were collected by a Mitutoyo digital caliper to 0.01 mm accuracy – using a binocular microscope and a Mitutoyo communication adapter MRS 100. For descriptive statistics, Shapiro-Wilk normality test, Kolmogorov-Smirnov two-sample test, t-test for independent samples, discriminant, canonical, and cluster analysis were used. All statistical analyses were performed using the Statistica 5.1 software.

Myotis csorbai sp. n.

Holotype – adult female: HNHM 97.2.4. (collector's No. CSORON 103), 4 km E of Syangja, 1300 m a.s.l., Syangja District, about 30 km S of Pokhara town, Nepal. Collected on 23 July 1995, by Dr. G. CSORBA. Alcoholic specimen, skull extracted. Deposited in the Department of Zoology, Hungarian Natural History Museum, Budapest.

Paratypes – four adult females: HNHM 97.2.1., 97.2.2., 97.2.3., 97.2.5. (collector's Nos CSORON 100, CSORON 101, CSORON 102, and CSORON 104, respectively), collected by Dr. G. CSORBA from the same locality and same date, deposited in the Department of Zoology, Hungarian Natural History Museum, Budapest. Further five specimens collected by A. BORISSENKO and S. KRUSKOP, at Bhurungdi river, about 30–40 km NW of Pokhara, Nepal. Alcoholic specimens, with extracted skull, deposited in the Zoological Museum of the Moscow University, Moscow: S–164481 female, S–164487 male, vicinity of Tirkhedunga, 1700 m, 14 May 1996, S–164483 female, S–164484 female, S–164490 male, vicinity of Sudame, 1500 m, 15–16 May 1996.

Diagnosis. Dark brownish black above, and dull grayish below, with smoky translucent grayish ears and membranes. Evidently darker than the species *M. longipes* from Kashmir. A small form, with shorter forearm and tibia and generally smaller cranial and mandibular measurements than in the species *M. longipes*.

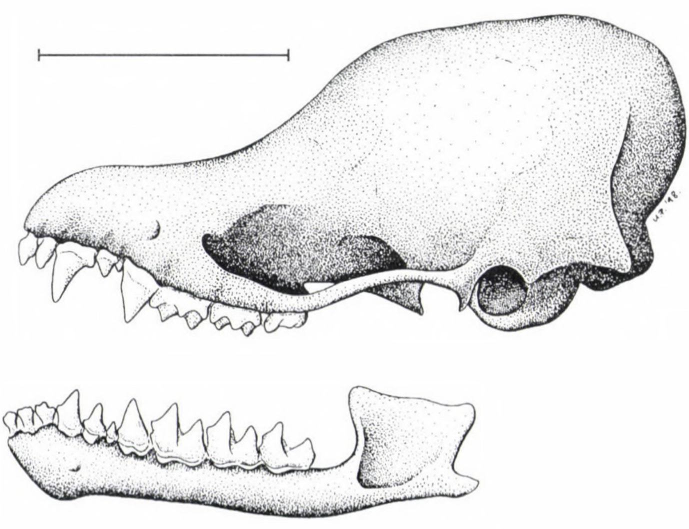


Fig. 1. Sketches of the skull and the mandible of *M. csorbai* sp. n..

Measurements with descriptive statistical data for external characters are included in Table 1, those of the skulls of the type series are given in Table 2, and for mandibles in Table 3. The skull and mandible of *M. csorbai* sp. n. are depicted in Fig. 1.

STATISTICAL COMPARISON

Comparison of external characters of Myotis csorbai *sp. n. and of* M. longipes

The descriptive statistics of external characters (forearm length and tibia length) of the Kashmiri *M. longipes*, as well as for the sample of the new species from Nepal are given separately for males and females, in Table 1. Brief results of the Kolmogorov-Smirnov test and the t-test, are reviewed here for pairs of samples. As regards forearm length, the Kolmogorov-Smirnov test unexpectedly showed significant ($p < 0.001$) difference of means between the males and females of the Kashmiri sample. The t-test at 0.001 alpha level gave the same result. There was no significant difference between the Kashmiri males and the Nepalese sample in the Kolmogorov-Smirnov test ($p < 0.01$). The difference in forearm length between the Kashmiri females and the Nepalese sample was highly significant ($p < 0.001$) by the Kolmogorov-Smirnov test. The t-test (at alpha level 0.001) gave the same result. There was a significant difference ($p < 0.005$) in forearm length between the Kashmiri *M. longipes* (sexes combined) and the Nepalese *M. csorbai* sp. n. by the Kolmogorov-Smirnov test. The means of the tibia lengths did no differ significantly between the slightly smaller males and the slightly larger females from Kashmir but showed significant differences both in the Kolmogorov-Smirnov test and the t-test when compared with those of the new species from Nepal. Standard discriminant analysis of the two external

Table 1. Descriptive statistics, forearm length and tibia length of *Myotis longipes*, Kashmir, and those of *Myotis csorbai* sp. n., Nepal (m = males, f = females)

Variable name	Species	Sex	N	Mean	min.	max.	std. dev.
Forearm length	*M. longipes*	m	33	37.20000	36.10	38.70	0.668954
		f	18	38.46667	36.60	39.70	0.926727
	M. csorbai	m	2	34.96000	34.80	35.12	0.226274
		f	8	36.30500	35.50	37.50	0.734769
Tibia length	*M. longipes*	m	33	16.68788	15.70	17.60	0.515847
		f	18	17.02778	16.00	17.80	0.501534
	M. csorbai	m	2	15.14500	14.84	15.45	0.431335
		f	8	15.48000	15.10	15.80	0.258844

measurements showed some overlap between individuals of the two species. The measurements of almost all overlapping individuals of the species *M. longipes*, however, were taken after prolonged storage in alcohol.

Comparison of cranial and mandibular characters of males and females of Myotis longipes, *Kashmir and Afghanistan*

The descriptive statistics of the cranial measurements of the studied material of the species *M. longipes*, males and females respectively, are given in Table 2. Out of 49 cranial characters the means of females were slightly greater than males in 28, although the males had greater mean values in 11 measurements. Other 9 means were equal up to two decimals. According to the Kolmogorov-Smirnov test, there was no significant difference ($p > 0.10$) between the males and females in any cranial character. The same conclusion was drawn from the results of a t-test for independent samples.

Descriptive statistics of the mandibular measurements of the studied material of *M. longipes*, males and females, respectively, are given in Table 3. Out of 35 mandibular characters, in 19 the females had greater mean values, in 7 the males were larger, while in the other 9 the means were practically equal. In the Kolmogorov-Smirnov test and the t-test at 0.001 alpha level, there was no significant difference between the males and the females.

Comparison of M. csorbai *sp. n. and* M. longipes

Cluster analyses of data of all individuals were performed as exploratory studies. One of these, produced a tree diagram (Fig. 2) which was based on 14 cranial and 10 mandibular characters and included both sexes of *M. longipes*, and the new species. The unweighted pair-group average linkage method using Eucledian distances in this analysis linked the two clumps at 100 $(D_{link}/D_{max})*100$ distance, while each cluster was divided at less than 50 distances. Only one of the 10 specimens of *M. csorbai* sp. n. was placed in the cluster of *M. longipes*.

Descriptive statistics of cranial characters of *M. csorbai* sp. n. Nepal are given in Table 2. There was no overlap between the maximum values of the new species and the minimum values of *M. longipes* (*M. csorbai* sp. n. had absolutely smaller values) in the following measurements: condylobasal length, outer distance of C–C crowns, zygomatic width, mastoid width, nasal notch length, M^1–M^3 crown length, C–M^3 alveolar length and M^1–M^3 alveolar length.

Descriptive statistics of mandibular measurements of *M. csorbai* sp. n. are shown in Table 3. Measurements in which there was no overlap between the maximum values of the new species and the minimum values of *M. longipes* were: mandibular length and C–M_3 alveolar length.

The present sample of the Nepalese species was generally smaller than *M. longipes* (sexes combined) from Kashmir and Afghanistan. The differences ap-

Table 2. Descriptive statistics, cranial measurements of *Myotis longipes*, Kashmir-Afghanistan, and those of *Myotis csorbai* sp. n., Nepal (m = males, f = females)

Variable name	Species	Sex	N	Mean	min.	max.	std. dev.
Total skull length (distance between I1 anterior alveolus margin and occiput)	*M. longipes*	m	33	14.10394	13.52	14.53	0.220567
		f	19	14.24526	13.80	14.74	0.245546
		f	8	13.15625	12.81	13.64	0.238803
Condylobasal length (distance between I1 anterior alveolus margin and condyli)	*M. longipes*	m	33	13.30242	12.77	13.72	0.225874
		f	18	13.40333	12.89	13.76	0.261759
		f	8	12.36125	12.11	12.71	0.224336
Basal length (distance between anterior edge of palate and skull base edge)	*M. longipes*	m	33	10.45303	9.92	10.82	0.230576
		f	18	10.51444	10.04	10.85	0.230402
		f	8	9.71000	9.43	9.93	0.158745
Palatal length (distance between anterior and posterior edges of palate without spine)	*M. longipes*	m	32	5.93500	5.38	6.20	0.171521
		f	18	5.99889	5.70	6.24	0.158035
		f	8	5.50250	5.19	5.70	0.153413
Palato-maxillary length (distance between anterior edge of palate and palato-maxillary sinus)	*M. longipes*	m	33	5.03121	4.64	5.31	0.140396
		f	19	5.09211	4.81	5.35	0.170084
		f	8	4.66750	4.54	4.78	0.079955
Inner distance of M2-M2 (measured between talons)	*M. longipes*	m	33	2.75273	2.59	2.97	0.095140
		f	18	2.74722	2.47	2.88	0.109319
	M. csorbai	m	2	2.38500	2.37	2.40	0.021213
		f	8	2.57875	2.49	2.67	0.065124
Outer distance of C-C crowns (including cingula)	*M. longipes*	m	32	3.66438	3.52	3.89	0.085796
		f	18	3.68944	3.53	3.84	0.085024
	M. csorbai	m	2	3.33500	3.33	3.34	0.007071
		f	8	3.36625	3.21	3.50	0.107960
Outer alveolar distance of C-C	*M. longipes*	m	33	3.58848	3.41	3.79	0.081514
		f	18	3.57889	3.42	3.71	0.078582
	M. csorbai	m	2	3.17500	3.16	3.19	0.021213
		f	8	3.30125	3.13	3.43	0.099202
Outer distance of M3-M3 crowns	*M. longipes*	m	33	5.66061	5.47	6.04	0.107265
		f	18	5.64944	5.41	5.91	0.135320
	M. csorbai	m	2	5.02000	4.97	5.07	0.070711
		f	8	5.35750	5.25	5.47	0.091768

Table 2 continued

Outer alveoli of M3-M3 (measured between exteriormost edges)	*M. longipes*	m	33	5.58727	5.38	5.97	0.119511
		f	18	5.58500	5.39	5.89	0.134175
		f	8	5.25500	5.13	5.41	0.105153
Zygomatic width	*M. longipes*	m	33	8.60667	8.31	8.90	0.143018
		f	18	8.69500	8.36	9.02	0.173790
	M. csorbai	m	2	7.66500	7.59	7.74	0.106066
		f	8	7.95125	7.81	8.19	0.134848
Braincase width	*M. longipes*	m	33	7.05242	6.66	7.34	0.144850
		f	18	7.04222	6.79	7.29	0.113891
	M. csorbai	m	2	6.44500	6.38	6.51	0.091924
		f	8	6.46500	6.31	6.72	0.139386
Mastoid width	*M. longipes*	m	33	7.24455	7.00	7.56	0.136659
		f	18	7.26167	7.01	7.44	0.117386
	M. csorbai	m	2	6.50500	6.49	6.52	0.021213
		f	8	6.75250	6.59	6.97	0.121626
Interorbital constriction	*M. longipes*	m	33	3.48970	3.26	3.69	0.104866
		f	18	3.45167	3.29	3.59	0.091475
	M. csorbai	m	2	3.20000	3.13	3.27	0.098995
		f	8	3.21750	3.07	3.43	0.113861
Lachrymal bridge width (that is anteorbital bridge width)	*M. longipes*	m	33	1.02152	0.87	0.22	0.076368
		f	19	1.03474	0.85	1.32	0.113987
	M. csorbai	m	2	0.91500	0.89	0.94	0.035355
		f	8	0.91500	0.77	0.99	0.092273
Lachrymal width	*M. longipes*	m	33	4.74848	4.54	4.93	0.107300
		f	18	4.78444	4.59	5.04	0.125099
	M. csorbai	m	2	4.16500	4.13	4.20	0.049497
		f	8	4.37750	4.21	4.54	0.102365
Nasal notch width	*M. longipes*	m	32	1.72187	1.45	1.87	0.090605
		f	19	1.73526	1.55	1.86	0.082622
	M. csorbai	m	2	1.59000	1.53	1.65	0.084853
		f	8	1.60750	1.52	1.66	0.044960
Nasal notch length	*M. longipes*	m	32	1.87156	1.75	2.07	0.072695
		f	18	1.86211	1.72	2.03	0.096585
	M. csorbai	m	2	1.66500	1.59	1.74	0.106066
		f	8	1.69625	1.63	1.73	0.037009

Table 2 continued

Anterior palatal emargination width	*M. longipes*	m	31	1.53645	1.41	1.64	0.061403
		f	19	1.53526	1.38	1.66	0.073210
	M. csorbai	m	2	1.37000	1.35	1.39	0.028284
		f	8	1.46375	1.42	1.53	0.040333
Anterior palatal emargination length	*M. longipes*	m	31	1.29097	1.00	1.41	0.087649
		f	19	1.32579	1.08	1.44	0.086943
	M. csorbai	m	2	1.03500	1.01	1.06	0.035355
		f	8	1.21375	1.03	1.28	0.079271
Palatal width behind toothrows (measured at narrowest part)	*M. longipes*	m	33	2.34667	2.24	2.46	0.049854
		f	18	2.35167	2.26	2.45	0.056906
	M. csorbai	m	2	2.06500	2.01	2.12	0.077782
		f	8	2.22250	2.05	2.30	0.083623
Width between cochleae (width of skull base)	*M. longipes*	m	33	1.35000	1.18	1.60	0.106125
		f	18	1.34722	1.22	1.49	0.082875
	M. csorbai	m	2	1.14500	1.14	1.15	0.007071
		f	8	1.19375	1.11	1.30	0.077263
Braincase height (from base of skull to top including sagittal crist)	*M. longipes*	m	33	5.48697	5.25	5.73	0.112208
		f	18	5.50389	5.22	5.78	0.132049
		f	8	5.12000	4.96	5.32	0.120475
C-M3 crown length	*M. longipes*	m	33	5.39485	5.11	5.56	0.105745
		f	19	5.41526	5.19	5.57	0.104900
	M. csorbai	m	2	4.83000	4.72	4.94	0.155563
		f	8	5.06000	4.93	5.19	0.087505
C-P4 crown length	*M. longipes*	m	33	2.39364	2.22	2.59	0.087957
		f	19	2.39263	2.25	2.55	0.078588
	M. csorbai	m	2	2.17000	2.07	2.27	0.141421
		f	8	2.25500	2.13	2.41	0.089762
Shortest distance between C and P4 (inner distance of crowns)	*M. longipes*	f	19	0.58263	0.41	0.65	0.056945
		f	19	0.58263	0.41	0.65	0.056945
		f	8	0.51750	0.41	0.59	0.070660
M1-M3 crown length	*M. longipes*	m	33	3.32273	3.21	3.46	0.074594
		f	19	3.33789	3.17	3.44	0.069248
	M. csorbai	m	2	2.91000	2.85	2.97	0.084853
		f	8	3.08750	2.95	3.16	0.075923

Table 2 continued

P4-M3 crown length	*M. longipes*	m	33	4.02727	3.86	4.23	0.099758
		f	19	4.03368	3.83	4.15	0.093227
	M. csorbai	m	2	3.61000	3.52	3.70	0.127279
		f	8	3.78750	3.61	3.91	0.095282
C basal length	*M. longipes*	m	33	0.85333	0.78	0.91	0.033973
		f	19	0.85263	0.81	0.90	0.026213
	M. csorbai	m	2	0.75500	0.74	0.77	0.021213
		f	8	0.82125	0.76	0.86	0.033991
P2 basal length	*M. longipes*	m	33	0.37364	0.32	0.45	0.029455
		f	19	0.38211	0.33	0.43	0.029170
	M. csorbai	m	2	0.33500	0.32	0.35	0.021213
		f	8	0.38875	0.35	0.45	0.031820
P4 basal length	*M. longipes*	m	33	1.06152	0.89	1.13	0.051728
		f	19	1.07579	0.96	1.15	0.050035
	M. csorbai	m	2	0.97000	0.94	1.00	0.042426
		f	8	1.03250	0.91	1.12	0.082245
M1 antero-posterior length	*M. longipes*	m	33	1.29424	1.22	1.38	0.042722
		f	19	1.31000	1.23	1.42	0.050222
	M. csorbai	m	2	1.10500	1.07	1.14	0.049497
		f	8	1.20625	1.14	1.24	0.037773
M2 antero-posterior length	*M. longipes*	m	33	1.28121	1.23	1.34	0.032669
		f	19	1.27632	1.18	1.36	0.039329
	M. csorbai	m	2	1.08500	1.04	1.13	0.063640
		f	8	1.21375	1.17	1.25	0.028754
M3 antero-posterior length	*M. longipes*	m	33	0.75727	0.71	0.82	0.026253
		f	19	0.75579	0.71	0.81	0.029120
	M. csorbai	m	2	0.67000	0.64	0.70	0.042426
		f	8	0.71000	0.67	0.75	0.032071
C crown width	*M. longipes*	m	33	0.66788	0.62	0.72	0.028368
		f	19	0.66842	0.64	0.70	0.017083
	M. csorbai	m	2	0.60500	0.59	0.62	0.021213
		f	8	0.61375	0.59	0.65	0.020659
P2 crown width	*M. longipes*	m	33	0.40879	0.36	0.45	0.020880
		f	19	0.40263	0.36	0.45	0.020774
	M. csorbai	m	2	0.37500	0.34	0.41	0.049497
		f	8	0.39000	0.36	0.43	0.025635

Table 2 continued

P4 crown width	*M. longipes*	m	33	0.92030	0.85	0.99	0.034685
		f	19	0.92053	0.85	0.98	0.040889
	M. csorbai	m	2	1.00000	0.97	1.03	0.042426
		f	8	0.94000	0.81	1.15	0.127839
M1 mesostylar width (distance between outer edge of mesostyl and innermost edge of talon)	*M. longipes*	m	33	1.43182	1.34	1.53	0.039879
		f	19	1.45474	1.37	1.54	0.037024
		f	8	1.33000	1.30	1.37	0.022678
M2 mesostylar width (distance between outer edge of mesostyl and innermost edge of talon)	*M. longipes*	m	33	1.63879	1.54	1.72	0.042994
		f	19	1.65789	1.58	1.73	0.036603
		f	8	1.53375	1.51	1.55	0.016850
M3 crown width	*M. longipes*	m	33	1.51515	1.44	1.62	0.040398
		f	19	1.51263	1.44	1.58	0.033140
	M. csorbai	m	2	1.34000	1.33	1.35	0.014142
		f	8	1.43000	1.37	1.47	0.035857
Tympanic bulla opening height	*M. longipes*	m	32	1.41750	1.22	1.58	0.095377
		f	19	1.46474	1.32	1.62	0.083757
	M. csorbai	m	2	1.32000	1.28	1.36	0.056569
		f	8	1.31250	0.94	1.50	0.197176
C-M3 alveolar length	*M. longipes*	m	29	5.26241	5.11	5.47	0.100983
		f	17	5.25706	5.04	5.48	0.128149
	M. csorbai	m	2	4.68000	4.55	4.81	0.183848
		f	8	4.91625	4.73	5.01	0.089911
C-P4 alveolar length	*M. longipes*	m	29	2.29966	2.18	2.51	0.084027
		f	17	2.32353	2.22	2.45	0.075576
	M. csorbai	m	2	2.08000	1.99	2.17	0.127279
		f	8	2.14500	2.02	2.29	0.091496
P4-M3 alveolar length	*M. longipes*	m	29	3.90966	3.74	4.09	0.102312
		f	17	3.88294	3.71	4.07	0.102394
	M. csorbai	m	2	3.43500	3.39	3.48	0.063640
		f	8	3.67250	3.47	3.77	0.089881
M1-M3 alveolar length	*M. longipes*	m	29	3.12828	3.01	3.25	0.066658
		f	17	3.11118	2.99	3.22	0.070168
	M. csorbai	m	2	2.71000	2.65	2.77	0.084853
		f	8	2.88250	2.78	2.96	0.062735

Table 2 continued

C alveolus length	*M. longipes*	m	29	0.71138	0.57	0.87	0.065341
		f	17	0.69706	0.61	0.77	0.047271
	M. csorbai	m	2	0.66000	0.62	0.70	0.056569
		f	8	0.68375	0.58	0.79	0.082104
P2 alveolus length	*M. longipes*	m	29	0.32828	0.28	0.39	0.030363
		f	17	0.34176	0.29	0.39	0.030462
	M. csorbai	m	2	0.31500	0.31	0.32	0.007071
		f	8	0.33000	0.29	0.39	0.041748
P4 outer alveolar length	*M. longipes*	m	29	0.94897	0.85	1.06	0.055507
(distance between anteriormost and posteriormost edges)		f	17	0.96765	0.88	1.03	0.047635
		f	8	0.89125	0.80	0.97	0.051391
Maxillary height at M2	*M. longipes*	m	33	0.67667	0.56	0.86	0.069402
		f	19	0.69895	0.61	0.81	0.057047
	M. csorbai	m	2	0.61500	0.59	0.64	0.035355
		f	8	0.59250	0.50	0.65	0.049785

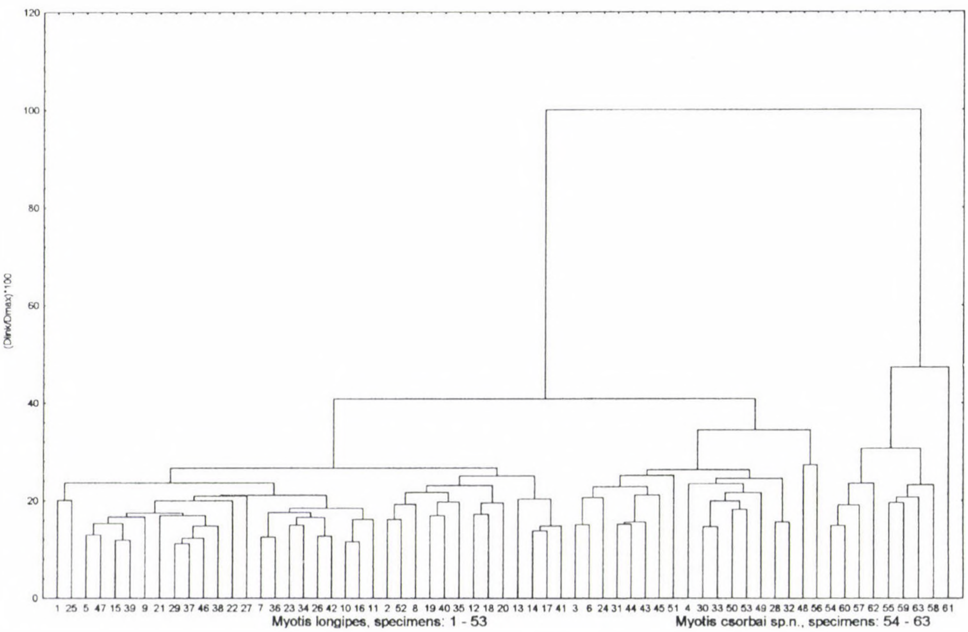


Fig. 2. Dendrogram by the unweighted pair-group linkage, Eucledian distances, processed from 24 cranial and mandibular data of *M. longipes*, Kashmir–Afghanistan (specimens 1–53), and *Myotis csorbai* sp. n., Nepal (specimens 54–63)

Table 3. Descriptive statistics, mandibular measurements (in mm) of *Myotis csorbai* sp. n., Nepal, and those of *M. longipes*, Kashmir–Afghanistan; m = males, f = females

Variable name	Species	Sex	N	Mean	min.	max.	std. dev.
Mandibular length (between I1 anterior alveolar edge and articular process)	*M. longipes*	m	33	10.35182	9.96	10.58	0.156214
		f	19	10.44316	9.93	10.78	0.238538
		f	8	9.57000	9.32	9.90	0.193317
C-M3 length (crowns)	*M. longipes*	m	33	5.70394	5.42	5.87	0.100993
		f	19	5.72421	5.46	5.88	0.124691
	M. csorbai	m	2	5.13000	4.97	5.29	0.226274
		f	8	5.34125	5.20	5.46	0.101339
C-P4 length (crowns)	*M. longipes*	m	33	2.18333	2.05	2.30	0.062733
		f	19	2.17526	2.03	2.32	0.073361
	M. csorbai	m	2	1.93500	1.87	2.00	0.091924
		f	8	2.06875	1.97	2.16	0.064683
Distance between C-P4 (shortest distance between crowns)	*M. longipes*	m	33	0.78182	0.65	0.91	0.065310
		f	19	0.77053	0.61	0.85	0.062135
		f	8	0.72500	0.55	0.85	0.088156
P4-M3 length (crowns)	*M. longipes*	m	33	4.23576	4.05	4.37	0.081969
		f	19	4.25526	4.12	4.35	0.068017
	M. csorbai	m	2	3.86500	3.77	3.96	0.134350
		f	8	3.97250	3.85	4.09	0.074210
M1-M3 length	*M. longipes*	m	33	3.53758	3.30	3.68	0.082312
		f	19	3.56105	3.31	3.69	0.092189
	M. csorbai	m	2	3.22000	3.13	3.31	0.127279
		f	8	3.34875	3.18	3.48	0.093264
C basal length	*M. longipes*	m	33	0.71970	0.58	0.78	0.043264
		f	19	0.72789	0.65	0.82	0.034088
	M. csorbai	m	2	0.65500	0.64	0.67	0.021213
		f	8	0.67875	0.63	0.79	0.048825
P2 basal length	*M. longipes*	m	33	0.45424	0.41	0.52	0.026696
		f	19	0.44316	0.39	0.49	0.027699
	M. csorbai	m	2	0.40500	0.39	0.42	0.021213
		f	8	0.45125	0.41	0.49	0.025319
P3 basal length	*M. longipes*	m	33	0.34000	0.24	0.40	0.035355
		f	19	0.32000	0.24	0.38	0.037417

Table 3 continued

	M. csorbai	m	2	0.32500	0.29	0.36	0.049497
		f	8	0.32250	0.28	0.39	0.034538
P4 basal length	*M. longipes*	m	33	0.73091	0.61	0.81	0.049077
		f	19	0.73895	0.69	0.80	0.034624
	M. csorbai	m	2	0.67500	0.66	0.69	0.021213
		f	8	0.68750	0.64	0.73	0.028158
M1 antero-posterior length	*M. longipes*	m	33	1.25788	1.15	1.35	0.04471
		f	19	1.26105	1.13	1.33	0.050321
	M. csorbai	m	2	1.14500	1.10	1.19	0.063640
		f	8	1.21625	1.13	1.29	0.055790
M2 antero-posterior length	*M. longipes*	m	33	1.26030	1.16	1.35	0.038445
		f	19	1.27421	1.20	1.36	0.040182
	M. csorbai	m	2	1.17000	1.12	1.22	0.070711
		f	8	1.20625	1.15	1.26	0.039978
M3 antero-posterior length	*M. longipes*	m	33	1.15788	1.07	1.24	0.035157
		f	19	1.15842	1.10	1.26	0.036157
	M. csorbai	m	2	1.05500	1.02	1.09	0.049497
		f	8	1.10625	1.06	1.15	0.029246
C-M3 alveolar length	*M. longipes*	m	29	5.60448	5.44	5.77	0.088825
		f	17	5.60176	5.39	5.78	0.124862
	M. csorbai	m	2	5.04000	4.89	5.19	0.212132
		f	8	5.25000	5.08	5.40	0.117716
C-P4 alveolar length	*M. longipes*	m	29	2.09966	1.95	2.26	0.060148
		f	17	2.10882	1.97	2.24	0.076066
	M. csorbai	m	2	1.94000	1.93	1.95	0.014142
		f	8	1.96750	1.89	2.04	0.061586
P2-P3 alveolar length	*M. longipes*	m	29	0.70138	0.62	0.79	0.043484
		f	17	0.71647	0.63	0.83	0.056451
	M. csorbai	m	2	0.65000	0.62	0.68	0.042426
		f	8	0.67250	0.64	0.73	0.034538
P4-M3 alveolar length	*M. longipes*	m	29	4.20483	4.00	4.34	0.086173
		f	17	4.21000	4.07	4.33	0.071502
	M. csorbai	m	2	3.78500	3.70	3.87	0.120208
		f	8	3.90750	3.80	4.07	0.095581
M1-M3 alveolar length	*M. longipes*	m	29	3.40862	3.21	3.54	0.079450
		f	17	3.41824	3.23	3.56	0.070377

Table 3 continued

	M. csorbai	m	2	3.06500	2.99	3.14	0.106066
		f	8	3.22250	3.13	3.31	0.061354
C alveolus length	*M. longipes*	m	29	0.55241	0.45	0.65	0.045877
		f	17	0.57765	0.50	0.66	0.043521
	M. csorbai	m	2	0.50000	0.47	0.53	0.042426
		f	8	0.52250	0.45	0.64	0.069847
P2 alveolus length	*M. longipes*	m	29	0.37276	0.31	0.42	0.032612
		f	17	0.39059	0.33	0.43	0.025365
	M. csorbai	m	2	0.33500	0.31	0.36	0.035355
		f	8	0.35250	0.30	0.38	0.027646
P3 alveolus length	*M. longipes*	m	29	0.27690	0.22	0.34	0.025788
		f	17	0.28824	0.22	0.34	0.036612
	M. csorbai	m	2	0.26000	0.26	0.26	0.000000
		f	8	0.25500	0.21	0.28	0.022039
P4 alveolar length	*M. longipes*	m	29	0.66759	0.59	0.72	0.031013
		f	17	0.67529	0.61	0.76	0.036592
	M. csorbai	m	2	0.59500	0.58	0.61	0.021213
		f	8	0.60625	0.53	0.70	0.057802
C crown width	*M. longipes*	m	33	0.54939	0.51	0.59	0.019516
		f	19	0.55263	0.53	0.59	0.017589
	M. csorbai	m	2	0.51500	0.51	0.52	0.007071
		f	8	0.50875	0.48	0.54	0.018077
P2 crown width	*M. longipes*	m	33	0.45030	0.41	0.50	0.017045
		f	19	0.44684	0.41	0.48	0.018872
	M. csorbai	m	2	0.41500	0.41	0.42	0.007071
		f	8	0.42875	0.40	0.46	0.021671
P3 crown width	*M. longipes*	m	33	0.32848	0.26	0.38	0.028736
		f	19	0.31526	0.22	0.42	0.042605
	M. csorbai	m	2	0.32000	0.30	0.34	0.028284
		f	8	0.33000	0.25	0.38	0.041404
P4 crown width	*M. longipes*	m	33	0.55576	0.51	0.61	0.026579
		f	19	0.55474	0.51	0.60	0.023657
	M. csorbai	m	2	0.52500	0.52	0.53	0.007071
		f	8	0.53375	0.50	0.57	0.021998
M1 talonid width	*M. longipes*	m	33	0.84091	0.77	0.92	0.038435
		f	19	0.83105	0.79	0.87	0.020520

Table 3 continued

	M. csorbai	m	2	0.76500	0.73	0.80	0.049497
		f	8	0.78625	0.73	0.85	0.041036
M2 talonid width	*M. longipes*	m	33	0.84394	0.78	0.92	0.032301
		f	19	0.84158	0.80	0.89	0.023396
	M. csorbai	m	2	0.76000	0.73	0.79	0.042426
		f	8	0.78500	0.77	0.80	0.011952
M3 trigonid width	*M. longipes*	m	33	0.75485	0.71	0.85	0.031337
		f	19	0.75947	0.71	0.81	0.021978
	M. csorbai	m	2	0.67000	0.65	0.69	0.028284
		f	8	0.70750	0.67	0.75	0.027646
M3 talonid width	*M. longipes*	m	33	0.62000	0.57	0.67	0.021794
		f	19	0.61789	0.57	0.66	0.023233
	M. csorbai	m	2	0.53500	0.53	0.54	0.007071
		f	8	0.58500	0.56	0.61	0.016036
Mandibular body height under M1	*M. longipes*	m	33	1.29913	1.08	1.45	0.082015
		f	12	1.34250	1.20	1.49	0.093917
	M. csorbai	m	2	1.10500	1.07	1.14	0.049497
		f	8	1.17375	1.00	1.31	0.100276
Mandibular body height behind M3	*M. longipes*	m	33	1.31667	1.18	1.40	0.049223
		f	19	1.32000	1.25	1.38	0.037712
	M. csorbai	m	2	1.24500	1.24	1.25	0.007071
		f	8	1.18875	1.13	1.28	0.049407
Processus coronoideus height (from lower sinus of mandibular body to top of process)	*M. longipes*	m	33	2.72182	2.57	2.86	0.076504
		f	19	2.74632	2.58	2.89	0.092749
		f	8	2.50625	2.34	2.68	0.109144
Symphysis length	*M. longipes*	m	33	2.07217	1.89	2.24	0.097045
		f	11	2.14091	1.98	2.26	0.086540
	M. csorbai	m	2	1.81000	1.73	1.89	0.113137
		f	8	1.88500	1.70	2.03	0.101559
Processus articularis width	*M. longipes*	m	33	1.24545	1.02	1.43	0.075667
		f	19	1.28105	1.06	1.45	0.082455
	M. csorbai	m	2	1.11500	1.11	1.12	0.007071
		f	8	1.16750	1.11	1.22	0.037321

peared in the Kolmogorov-Smirnov test as highly significant ($p < 0.001$) in 34 and significant ($p < 0.005$) in five out of 50 cranial characters. However, the following measurements did not differ significantly: shortest distance between C–P^4, C basal length, P^2 basal length, P^4 basal length, M^3 antero-posterior length, P^2 crown width, P^4 crown width, tympanic bulla opening height, upper C alveolus length, P^2 alveolus length, P^4 outer alveolar length. The t-test at 0.001 alpha level gave significant differences also in means of lachrymal bridge width, width between cochleae, C basal length, M^3 antero-posterior length and P^4 outer alveolar length.

In the Kolmogorov-Smirnov test, 11 out of 35 mandibular characters did not differ significantly: distance between C–P_4, P_2 basal length, P_3 basal length, M_1 antero-posterior length, P_2–P_3 alveolar length, lower C alveolus length, P_2 alveolus length, P_3 alveolus length, P_2 crown width, P_3 crown width and P_4 crown width. Besides these, in the t-test P_4 basal length and M_1 talonid width did not differ significantly, however, at the 0.001 alpha level the test produced significant difference also in P_2 crown width.

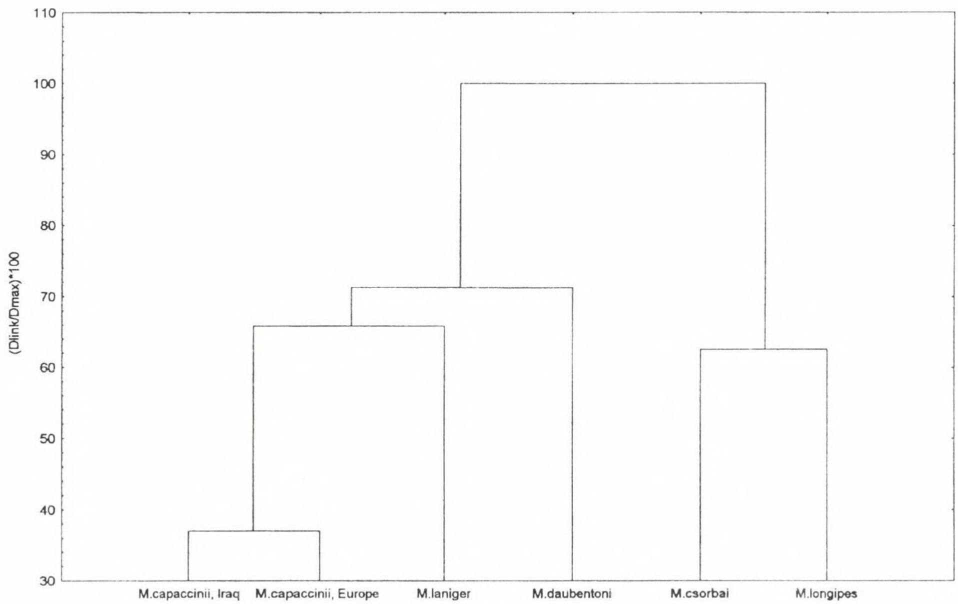


Fig. 3. Dendrogram by the unweighted pair-group average method, Eucledian distances of group centroids after discriminant analysis, standard method and canonical analysis, roots 1–5 of 13 cranial measurements (normally distributed in *M. csorbai* sp. n. as shown by Shapiro-Wilk test) of *Myotis csorbai* sp. n., Nepal; *M. longipes*, Kashmir–Afghanistan; *M. laniger*, Vietnam–India (Meghalaya)–China; *M. daubentoni*, Europe; *M. capaccinii*, Europe; *M. capaccinii*, Iraq

Comparison of M. csorbai *sp. n. and* M. daubentoni

As regards the cranial characters, the Kolmogorov-Smirnov test showed highly significant ($p < 0.001$) differences in 34 out of 49 measurements (i.e. in total skull length, condylobasal length, basal length, inner distance of M^2–M^2, outer distance of C–C crowns, outer alveolar distance of C–C, outer distance of M^3–M^3 crowns, outer alveoli of M^3–M^3, zygomatic width, braincase width, mastoid width, interorbital constriction, lachrymal bridge width, lachrymal width, nasal notch width, nasal notch length, anterior palatal emargination width, anterior palatal emargination length, palatal width behind toothrows, width between cochleae, braincase height, C–M^3 crown length, shortest distance between C and P^4, M^1–M^3 crown length, P^2 basal length, M^1 antero-posterior length, M^3 antero-posterior length, C crown width, P^2 crown width, M^1 mesostylar width, tympanic bulla opening height, C–M^3 alveolar length, C–P^4 alveolar length, and maxillary height at M^2). Significant difference ($p < 0.005$) was observed in palato-maxillary length and P^2 alveolus length. Besides, the t-test showed significance at 0.001 alpha level in 36 measurements (in almost all – except palato-maxillary length – of the above measurements as in Kolmogorov-Smirnov test, further in C–P^4 crown length). In most of the above characters except lachrymal bridge width, the means of *M. daubentoni* were greater, with high significance ($p < 0.001$), furthermore, in P^4 basal length and P^4 crown width where *M. csorbai* sp. n. had (however, not significantly) the greater means. Other cranial characters with no significantly different means were: palatal length, palato-maxillary length, P^4–M^3 crown length, C basal length, M^2 antero-posterior length, M^2 mesostylar width, M^3 crown width, P^4–M^3 alveolar length, M^1–M^3 alveolar length, C alveolus length and P^4 outer alveolar length.

In the Kolmogorov-Smirnov test high significance ($p < 0.001$) was shown for differences between Nepalese *M. csorbai* sp. n. and the European *M. daubentoni* in 11 mandibular characters: mandibular length, C–M_3 length, C crown width, M_1 talonid width, M_2 talonid width, M_3 trigonid width, M_3 talonid width, mandibular body height under M_1, mandibular body height behind M_3, height of coronoid process and symphysis length, and good significant differences ($p < 0.005$) in further four. According to the t-test at alpha level 0.001, means of other five characters (C–P_4 length, M_1–M_3 length, M_1 antero-posterior length, C–M_3 alveolar length, P_3 width,) were significantly different too. In almost all of these variables, *M. daubentoni* was greater than the Nepalese form. In P_4 basal length ($p < 0.005$), then in M_1 antero-posterior length, M_2 antero-posterior length, and P_4 alveolar length, however, the new species had greater values.

Comparisons of M. csorbai *sp. n. and* M. laniger

Based on the results of the Kolmogorov-Smirnov test, the two samples differed with high significance ($p < 0.001$) in 18 of 49 characters: total skull length, condylobasal length, inner distance of M^2–M^2, outer distance C–C crowns, outer alveolar distance of C–C, outer alveoli of M^3–M^3, braincase width, mastoid width, nasal notch width, nasal notch length, braincase height, C–M^3 crown length, C–P^4 crown length, shortest distance between C and P^4, C basal length, P^2 basal length, C–M^3 alveolar length and P^2 alveolus length, rather significantly ($p < 0.005$) in 13 cranial characters (basal length, palatal length, palato-maxillary length, zygomatic width, interorbital constriction, lachrymal width, palatal width behind toothrows, M^1–M^3 crown length, M^1 antero-posterior length, P^2 crown width, M^1 mesostylar width, C–P^4 alveolar length and maxillary height at M^2). Besides the above listed, the t-test at 0.001 alpha level showed also significant difference for outer distance of M^3–M^3 crowns, anterior palatal emargination width and anterior palatal emargination length, however, not so for M^1–M^3 crown length and M^1 antero-posterior length. In almost all of these measurements the species *M. laniger* was somewhat larger than the new *M. csorbai* sp. n. The latter had greater means in lachrymal bridge width, width between cochleae, P^4 basal length and P^4 crown width, however, not significantly. In P^4 outer alveolar length the means of the two species agreed up to two decimals. Unfortunately, both samples were limited in size, thus the results of the t-test were less conclusive.

In mandibular characters the Kolmogorov-Smirnov test resulted in highly significant differences ($p < 0.001$) in 7 characters (mandibular length, C–M_3 length, C–P_4 length, C–M_3 alveolar length, C–P_4 alveolar length, P_2–P_3 alveolar length and P_3 alveolus length). There were significant differences ($p < 0.005$) in further ten characters (distance between C–P_4, P_4–M_3 length, C basal length, P_2 basal length, P_3 basal length, P_2 crown width, P_3 crown width, mandibular body height behind M_3, processus coronoideus height and processus articularis width). According to the t-test at 0.001 alpha level, almost all the above listed characters were also significantly different (except C basal length), here the P_4–M_3 alveolar length and symphysis length were added. In all mandibular measurements studied, *M. laniger* had the greater means.

Comparison of M. csorbai *sp. n. and of* M. capaccinii

As a result of the Kolmogorov-Smirnov test and t-test at 0.001 alpha level, there were highly significant differences in the means of almost all cranial characters. However, the P^4 basal length, P^4 crown width and P^4 outer alveolar length – according to the Kolmogorov-Smirnov test – did not differ significantly, but in the t-test the P^4 outer alveolar length was also significantly different. In lachrymal bridge width the sample of Nepalese *M. csorbai* sp. n. had significantly greater values, *M. capaccinii* evidently so in the other measurements.

As regards the mandibular characters, all measurements were found with significantly different means in the Kolmogorov-Smirnov test and the t-test combined. The means of *M. capaccinii* had the greater values.

Comparison of M. longipes *and* M. daubentoni

The Kolmogorov-Smirnov test comparing Kashmiri and Afghan population of *M. longipes* and *M. daubentoni* resulted in highly significant differences in means ($p < 0.001$) in 33 out of 49 cranial characters (total skull length, palatal length$^+$, palato-maxillary length$^+$, inner distance of M^2–M^2, zygomatic width, braincase width, mastoid width, interorbital constriction, lachrymal bridge width$^+$, nasal notch length, anterior palatal ematgination width, anterior palatal ematgination length, palatal width between toothrows, width between cochleae, C–M^3 crown length$^+$, shortest distance between C and P^4, M^1–M^3 crown length$^+$, P^4–M^3 crown length$^+$, P^2 basal length, P^4 basal length$^+$, M^2 antero-posterior length$^+$, P^2 crown width, M^1 mesostylar width$^+$, M^2 mesostylar width$^+$, M^3 crown width$^+$, tympanic bulla opening height, C–M^3 alveolar length$^+$, P^4–M^3 alveolar length$^+$, M^1–M^3 alveolar length$^+$, P^2 alveolus length, P^4 outer alveolar length$^+$ and maxillary height at M^2, or good difference of means ($p < 0.005$) in lachrymal width$^+$). In 16 characters (marked with $^+$) the species *M. longipes* was large, whereas in other 17 measurements *M. daubentoni* had significantly greater means. There were no significant differences in other 13 measurements (the markings as above: condylobasal length, basal length$^+$, outer distance of C–C crowns, outer alveolar distance of C–C, outer distance of M^3–M^3 crowns, outer alveoli of M^3–M^3, nasal notch width, braincase height$^+$, C–P^4 crown length$^+$, C basal length$^+$, M^1 antero-posterior length$^+$, M^3 antero-posterior length and P^4 crown width$^+$). The means in C crown width, C–P^4 alveolar length and C alveolus length means were equal in the two species up to two decimals. The t-test at 0.001 alpha level resulted in exactly the same results.

The Kolmogorov-Smirnov test and the t-test showed highly significant ($p < 0.001$) differences between means of *M. longipes*, and *M. daubentoni* in the following mandibular characters: mandibular length, C–M_3 length, P_4–M_3 length, M_1–M_3 length, P_4 basal length, M_1 antero-posterior length, M_2 antero-posterior length, M_3 antero-posterior length, C–M_3 alveolar length, C–P_4 alveolar length, P_4–M_3 alveolar length, M_1–M_3 alveolar length, P_4 alveolar length, lower C crown width^, P_2 crown width (but in t-test), P_3 crown width^, processus coronoideus height^, symphysis length^, or good ($p < 0.005$) differences for M_3 talonid width^ and P_2 crown width^. There were no significant differences (the two species were least different) in C–P_4 length, P_2 basal length, P_3 basal length^, P_2–P_3 alveolar length^, C alveolus length, P_2 alveolus length, P_3 alveolus length, P_4 crown width, M_1 talonid width^, M_2 talonid width, M_3 trigonid width^, mandibular body height under M_1^, mandibular body height behind M_3^ and in processus

articularis width. *M. daubentoni* was somewhat smaller with overlaps in the majority of cases (practically in the longitudinal measurements), but in characters marked with ^ it was more or less greater (in the width measurements and strengths of mandible).

Comparison of M. longipes *and* M. laniger

Among the 49 cranial characters 7 were highly significantly different in means between the two samples ($p < 0.001$) (lachrymal bridge width, C–P^4 crown length^, shortest distance between C and P^4^, P^2 basal length^, M^3 crown width, C–P^4 alveolar length^ and P^2 alveolus length^), or rather ($p < 0.005$) significantly different means in 11 characters (total skull length^, inner distance of M^2–M^2^, anterior palatal emargination width^, C–M^3 crown length^, M^1–M^3 crown length, P^4 basal length, M^2 antero-posterior length, P^2 crown width^, M^2 mesostylar width, C–M^3 alveolar length^ and C alveolus length^). Measurements proved to be also significantly different in the t-test at 0.001 alpha level in condylobasal length^, outer distance of C–C crowns^, width between cochleae, C basal length^ P^4 crown width. In characters marked with ^ the species *M. laniger* had

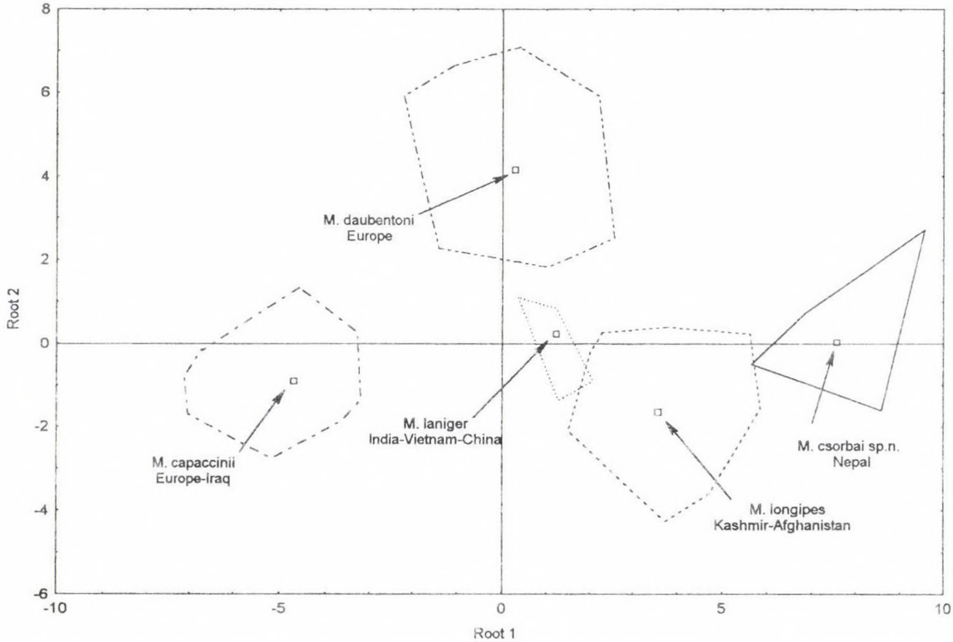


Fig. 4. Root 1 vs root 2, scatterplot with group centroids (arrows) after discriminant analysis, standard method and canonical analysis from 11 cranial and mandibular measurements (normally distributed in *M. longipes* as shown by Shapiro-Wilk test) of *Myotis csorbai* sp. n., Nepal; *M. longipes*, Kashmir–Afghanistan; *M. laniger*, Vietnam–India (Meghalaya)–China; *M. daubentoni*, Europe; *M. capaccinii*, Europe, Iraq

significantly greater means. Whereas in lachrymal bridge width, width between cochleae, M^1–M^3 crown length, P^4 basal length, M^2 antero-posterior length, M^2 mesostylar width and M^3 width *M. longipes* was significantly greater, as shown above. There were no significant differences in other 22 characters (9 of them was greater in *M. longipes*), and in two (C crown width and M3 antero-posterior length) the means agreed up to two decimals.

As regards the mandibular characters, in 9 out of 35 highly significant differences were found in the Kolmogorov-Smirnov test ($p < 0.001$), all in favour of *M. laniger* (C–M_3 length, C–P_4 length, P_2 basal length, P_3 basal length, C–M_3 alveolar length, C–P_4 alveolar length, P_2–P_3 alveolar length, P_3 alveolus length and P_3 crown width). Moderate significance ($p < 0.005$) was found for two: distance between C–P_4 and P_2 crown width. The t-test at 0.001 alpha level also showed all of the above listed characters as significantly different, so the results of the two tests were practically equal. Regarding the means of mandibular characters of the two species, *laniger* had greater ones in 20 (out of these 11 were significantly different). Means of 9 measurements were greater in *longipes* than in *laniger* (but not significantly so). Means of 6 characters were equal (up to two decimals). To sum up, the species *M. longipes* seemed to have shorter anterior portion of the lower dentition, and its one rooted premolars were also narrower, than in *M. laniger*. The length of mandible, the P_4–M_3 row and the mandibular characters defining its strength did not differ significantly from those of *M. laniger*, however, they did so in the comparison of *M. csorbai* sp. n. and *M. laniger*.

Comparison of Kashmiri and Afghan M. longipes *and* M. capaccinii

It was seen that there were highly ($p < 0.001$) significant differences between the two species in 41 out of 49 cranial characters using the Kolmogorov-Smirnov test (the t-test gave exactly the same results). Besides, the means of *M. capaccinii* had the greater values except the lachrymal bridge width where the mean value of *M. longipes* significantly was greater. Although not significantly, also in M^1 antero-posterior length, M^1–M^3 alveolar length and P^4 outer alveolar length *M. longipes* had greater means. Other characters where no significant differences were found are the following: M^1–M^3 row length, P^4 basal length, M^2 antero-posterior length, M^3 crown width and P^4–M^3 alveolar length.

There were found highly significant differences ($p < 0.001$) in almost all (32) of the 35 mandibular characters, furthermore, significant difference ($p < 0.005$) in M_2 talonid width by the Kolmogorov-Smirnov test. There were no significant differences in M_1 talonid width and processus articularis width by the same test. The t-test at 0.001 alpha level gave similar result with the exception that the means of M_1 talonid width also significantly differed in the two species. The species *M. capaccinii* had generally much greater measurements and means than *M. longipes* did.

Comparison of M. daubentoni *and* M. laniger

There are old controversies regarding the conspecifity of this two species (ELLERMANN & MORRISON-SCOTT op. cit., CORBET op. cit., CORBET & HILL op. cit.). A highly significant difference ($p < 0.001$) between the means of cranial characters of the two species was shown by the Kolmogorov-Smirnov test in braincase width, interorbital constriction, lachrymal bridge width^, width between cochleae, C–M^3 row length^, C basal length^, C–M^3 alveolar length^ and C–P^4 alveolar length^ and good significant difference ($p < 0.005$) in palatal length^, palato-maxillary length^, mastoid width, C–P^4 crown length^ and tympanic bulla opening height. The t-test at 0.001 alpha level showed significant differences also in shortest distance between C–P^4^, P^2 basal length^, P^4–M^3 alveolar length^, upper C alveolus length^, P^2 alveolus length^ and maxillary height at M^2. The characters marked with ^ had greater values in means of *M. laniger*, while in the other measurements *M. daubentoni* was significantly greater.

A highly significant difference ($p < 0.001$) between the means of mandibular characters of the two species was shown by the Kolmogorov-Smirnov test in 12 out of 35 mandibular characters (C–M_3 length, C–P_4 length, distance between C–P_4, P_2 basal length, P_3 basal length, P_4 basal length, C–M_3 alveolar length, C–P_4 alveolar length, P_2–P_3 alveolar length, P_3 crown width and processus coronoideus height). Rather good significance ($p < 0.005$) was found in P_4–M_3 length, P_4–M_3 alveolar length and C crown width. In the t-test other significant differences were shown in mandibular length, M_1 antero-posterior length, M_2 antero-posterior length, however not for C crown width. Almost all significantly different characters – except C crown width and processus coronoideus height – had greater means in *M. laniger*. Of the other measurements without significantly differing means the following averaged larger in *M. laniger*: M_1–M_3 length, C basal length, M_3 antero-posterior length, M_1–M_3 alveolar length, C alveolus length, P_2 alveolus length, P_4 alveolar length and processus articularis width, while the others: M_1 talonid width, M_2 talonid width, M_3 trigonid width, M_3 talonid width, mandibular body height under M_1, mandibular body height behind M_3 and symphysis length were greater in *M. daubentoni*.

Comparison of M. daubentoni *and* M. capaccinii

The statistical analysis of these two well-known European species by the Kolmogorov-Smirnov test (and exactly the same in t-test) brought also some results which were useful in the present series of statistical work. In most of the cranial characters (in 43 out of 49) the species *M. daubentoni* had significantly ($p < 0.001$) smaller means, although in the case of interorbital constriction the mean was significantly greater in *M. daubentoni* than in *M. capaccinii*. Among the characters with no significant differences: nasal notch length, anterior palatal

emargination length, width between cochleae, M^1 antero-posterior length and maxillary height at M^2, but the last one was slightly stronger in *M. daubentoni*.

As regards the mandibular characters, the Kolmogorov-Smirnov test showed high significance ($p < 0.001$) in 26 and moderate significance ($p < 0.005$) in one (C crown width) out of the 35 characters, all in favour of *M. capaccinii*. Besides these, according to the t-test at 0.001 alpha level, mandibular body height behind M_3 was also significantly greater in *M. capaccinii* than in *M. daubentoni*. Among the characters with no significant differences: M_1 talonid width, M_2 talonid width, M_3 trigonid width, M_3 talonid width, processus coronoideus height, symphysis length and processus articularis width, but the symhysis length seemed to be stronger in *M. daubentoni* in the present study material.

Comparison of M. laniger *and* M. capaccinii

The present studies made it clear that there are clear differences between these two species. Out of 49 cranial characters, in 30 there were found highly significant ($p < 0.001$) differences in means by the Kolmogorov-Smirnov test. (*M. capaccinii* was significantly greater in: total skull length, condylobasal length, basal length, outer distance of C–C crowns, outer alveolar distance of C–C, outer distance of M^3–M^3 crowns, outer alveoli of M^3–M^3, zygomatic width, braincase width, mastoid width, interorbital constriction, palatal width behind toothrows, width between cochleae, braincase height, C–M^3 crown length, M^1–M^3 crown length, P^4–M^3 crown length, C basal length, M^3 antero-posterior length, M^1 mesostylar width, M^2 mesostylar width and M^3 crown width.) Moderately significant difference ($p < 0.005$) was found in further three characters: C–P^4 crown length, P^4 basal length and P^4 crown width. The t-test at 0.001 alpha level showed all the same measurements, and in addition palatal length, inner distance of M^2–M^2, lachrymal width, nasal notch length, M^2 antero-posterior length, C–P^4 alveolar length and P^4 outer alveolar length as significantly different too. All the measuremens with significantly different means were greater in *M. capaccinii*. The means of lachrymal bridge width and shortest distance between C and P^4 were larger (not significantly) in *M. laniger*. Finally, the means of nasal notch width agreed up to two decimals in the two species.

Of the 35 mandibular characters the means of 10 had highly significant differences ($p < 0.001$) in favour of *M. capaccinii* (mandibular length, C–M_3 length, P_4–M_3 length, M_1–M_3 length, M_2 antero-posterior length, M_3 antero-posterior length, C–M_3 alveolar length, P_4–M_3 alveolar length, C alveolus length and C crown width). Six measurements had moderate significant differences ($p < 0.005$) (P_4 basal length, M_1 antero-posterior length, M_1–M_3 alveolar length, M_3 talonid width, mandibular body height behind M_3 and processus coronoideus height). The t-test at 0.001 alpha level – besides the characters listed above – also gave significant differences for means of C basal length, M_1–M_3 alveolar length,

P_3 alveolus length, P_4 alveolar length, C crown width, P_4 crown width and mandibular body height under M_1. The reason for the rather different results of the Kolmogorov-Smirnov test and that of t-test was probably because of the comparatively small sample size of *M. laniger*. The majority of the means were greater in *M. capaccinii*, however, greater in *M. laniger* in P_2 basal length and processus articularis width. The means were more or less equal (up to two decimals) in shortest distance of C and P_4, as well as of P_3 crown width of the two species.

Comparison of European and Iraqi samples of M. capaccinii

To help clarify the relation of the European (*M. c. capaccinii*) and the West Asian (*M. c. bureschi*) populations, it was possible to compare a rather good South European and a medium-sized Iraqi sample. Strong significant differences ($p < 0.001$) and significant differences ($p < 0.005$) appeared in nine, and two cranial characters, respectively (palato-maxillary length>, inner distance of M^2–M^2>, zygomatic width>, braincase width>, mastoid width>, lachrymal width>, anterior palatal emargination width, width between cochleae>, shortest distance between C–P^4>, M^3 antero-posterior length>, P^4 crown width and M^1 mesostylar width), of the studied 35. Moreover, the t-test at alpha level 0.001 showed four more: the total skull length>, condylobasal length> and outer distance of C–C crowns and P^4 outer alveolar length to be significantly different.

Of the 35 mandibular characters only two (mandibular length, and processus coronoideus height) had highly significant ($p < 0.001$) differences, in addition one (P_2 basal length) had a moderate ($p < 0.005$) difference as based on the Kolmogorov-Smirnov test. The t-test also showed the same (with the exception of P_2 basal length) and also M_1 antero-posterior length, M_2 antero-posterior length and symphysis length as significantly different. The European *M. capaccinii* had greater means in 16 characters, reversely, the Iraqi sample was greater in 15 (M_1–M_3 length, P_2 basal length, P_4 basal length, M_1 antero-posterior length, M_2 antero-posterior length, C–M_3 alveolar length, P_4–M_3 alveolar length, M_1–M_3 alveolar length, P_2 alveolus length, P_3 alveolus length, P_4 alveolar length, P_2 crown width, P_3 crown width, M_1 talonid width and M_2 talonid width). In three measurements (P_4–M_3 length, P_3 basal length and C crown width) the means equalled up to two decimals in the two samples.

DISCUSSION

There were found to be significant differences in the means of the external measurements of the Kashmiri sample of *M. longipes* and the sample of *M. csorbai* sp. n. from Nepal.

According to the present analyses of *M. longipes* from Kashmir and Afghanistan, there were no significant differences between the sexes in any cranial characters. In mandibular characters, however, the females had significantly greater values in some measurements.

The present sample of *M. csorbai* sp. n. from Nepal was generally smaller than *M. longipes* (sexes combined) from Kashmir and Afghanistan. The two species differed evidently and significantly in almost all longitudinal cranial characters and length of the mandible, as well as in the width measurements of the rostrum and the skull, respectively. They also differed significantly in most of the upper and lower toothrow lengths, upper and lower C crown widths, width of upper molars, talonid width of the lower molars, the braincase height, strength of maxilla, and all the mandibular features expressing the strength of mandible. All in all, there were found differences especially in the ratios of various parts of dentition and some parts of the skull combined with the overall size of each species. The smaller, however not significantly smaller, measurements could mean relatively greater values in the smaller animal, in *M. csorbai* sp. n.

When the species *M. longipes* and *M. daubentoni* were compared, the former had greater values in numerous characters, while in others *M. daubentoni* showed significantly greater values, thus the ratios of characters differed considerably. Anyhow, the European species seemed to be rather distantly related to the other one.

The measurements of *M. csorbai* sp. n. were significantly shorter than those of *M. daubentoni*, with shorter toothrow, mostly because of the small size of the upper one-rooted premolars, narrower crowns, smaller rostral width and braincase width, less inflated bulla and lowered maxillary height. However, it had significantly higher values in the lachrymal bridge width, lower fourth premolar and the first molar length, and relatively greater large upper premolar as compared to the species *M. daubentoni*. The European species was stronger in the length of mandible, also in the width of canine, the talonid width of molars, and the mandibular body strength, including the processus coronoideus height and symphysis length.

As compared with *M. laniger*, a similar-sized species, *M. longipes* had a weaker anterior portion of the dentition. From the P^4 on, however, through the strength of the molars in the posterior portion of the toothrow, *M. longipes* appeared significantly longer and stronger, with wider teeth. *M. longipes* also had a significantly wider anteorbital (lachrymal) bridge.

The species *Myotis laniger* was significantly greater than *M. csorbai* sp. n. in all of the important longitudinal characters, including the toothrows. It had greater width measurements of rostrum and stronger mandible, and especially greater one-rooted premolars.

In some earlier authors' views (e.g. TATE op. cit., ELLERMAN & MORRISON-SCOTT op. cit.) the species *M. longipes* was placed with *M. capaccinii*. Later it was considered a distinct species (HANAK & GAISLER 1969, CORBET op. cit., CORBET & HILL op. cit.). While the sample of *M. longipes* was significantly smaller in most of the cranial characters, it differed from *M. capaccinii* in some respects. Regarding the mandibular characters *M. longipes* had strongly different means as compared with those of *M. capaccinii*. These results certainly expressed differences in ratios when the generally larger species (*M. capaccinii*) was compared to a small one (*M. longipes*). The smaller, however, not significantly smaller, measurements meant also relatively greater measurements in the smaller species, in this case in *M. longipes*. The phenetic distance of the two species (*M. longipes* and *M. capaccinii*) seemed to be greater than that of *M. longipes* either to *M. laniger* or to *M. daubentoni*.

The Nepalese *M. csorbai* sp. n. had strongly different measurements as compared with those of the much larger *M. capaccinii*. The large upper premolar appeared relatively larger, and the lachrymal bridge absolutely wider, however, in the new species.

In most of the cranial and mandibular characters the species *M. daubentoni* had significantly smaller means, although in the case of the interorbital constriction, the mean was significantly greater in *M. daubentoni* than in *M. capaccinii*. Among the characters with no significant differences the maxillary height and the symhysis length seemed to be stronger in *M. daubentoni*.

The rather long-lasting controversies regarding the conspecifity of *M. daubentoni* and *M. laniger* and the systematic position of the latter are still not over (CORBET and HILL op. cit.). The present analyses showed *M. laniger* to be farther from *M. daubentoni* than from *M. capaccinii*. Its distance to the latter, however, is also large enough to regard it as a separate member of the subgenus *Leuconoe* at species level.

The present studies have made it clear that there are clear differences between *M. laniger* and *M. capaccinii*, as most of the cranial and mandibular characters are different in the two species. *M. capaccinii* was significantly greater in all longitudinal measurements of the skull and the mandible including most of the toothrow lengths and individual teeth, nasal notch length, the posterior width measurements of rostrum and the width characters of the skull and braincase, braincase height, strength of the mandibular body and processus coronoideus height, the width of the upper great premolar and molars, lengths and width of the lower great premolar, length of lower molars and talonid width of lower M_3. Only one of the cranial characters P^4 outer alveolar length, was significantly greater in *M. laniger*.

For the study the relation of the European and the West Asian populations of *M. capaccinii* of which the only available name is probably *M. capaccinii bu-*

reschi (HEINRICH, 1936)(see HARRISON 1964, KOOPMAN op. cit.), it was possible to compare a rather good South European and a medium-sized Iraqi sample. Significant differences have found in 15 cranial and 6 mandibular characters.

* * *

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